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FROM THE BEQUEST OF

DANIEL TREADWELL

Rumford Professor and Lecturer on the Application
of Science to the Useful Arts
1834-1845

TECHNICAL WRITING

BY

T. A. RICKARD

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PREFACE

This little book has grown from a set of five lectures delivered before the engineering classes of the University of California in 1916. The text has been revised and expanded for the purpose of publication. It is a ticklish task to write on writing, because the effort provokes self-consciousness. Errors there will be, inevitably. The reader is welcome to the pleasure he may feel in detecting them, for the keenness of his criticism will be the measure of his interest in what he is reading. All I hope to accomplish by means of these printed lectures is to cause the members of my former profession "to sit up and take notice." Whether my criticisms prove unacceptable or my suggestions unwelcome does not matter, if the effect is to make the reader, as a writer, careful where before he was careless. The inculcation of rules and precepts is of small consequence compared with the awakening of interest in the proper use of language. If an intelligent man can be made to realize the importance of taking pains in writing, the rest is easy; self-criticism is the beginning of knowledge. Should this book succeed in arousing sympathetic interest in the important matter of literary expression, it will have served its purpose. As a revised edition is anticipated, I ask my readers to inform me of any errors they detect and to favor me with any criticisms they may care to offer, so that together we may labor in the cause of literary workmanship. The text has been read by several friends, to whom I am indebted for criticisms and suggestions. I desire to record my thanks to them, namely, Mr. George M. Wood, editor to the U. S. Geological Survey,

Mr. Cornelius B. Bradley, Professor Emeritus of English in the University of California, Mr. Courtenay De Kalb, Mr. Grant H. Smith, and Mr. C. Irving Wright.

T. A. RICKARD.

SAN FRANCISCO,
May 24, 1919.

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TECHNICAL WRITING

I. GENERAL PRINCIPLES.

It has been stated, by James Barrie, that "the man of science appears to be the only man who has something to say, just now—and the only man who does not know how to say it." The friendly jibe of the novelist contains enough exaggeration to make it humorous to the followers of Huxley and Spencer; but could any litterateur poke similar fun at the exponents of the avowedly utilitarian branches of science—the men of technology—without suggesting an unpleasant truth?

Indeed the engineer does bungle language deplorably. He makes a fetish of efficiency, yet he shows no regard for the effective use of one of his most important tools—the pen; he believes devoutly in accuracy, yet he employs a weapon of precision as carelessly as a small boy handles a gun. This inconsistency may be due to causes similar to those indicated by the Academic Senate when it undertook to explain the defective writing of the students in this* university. The Senate suggested that the student is "constantly subjected by his environment to the unedifying influence of myriad examples of poor English," and that he is also affected by "a certain public prejudice against correctness of expression." With this opinion most of us will agree. Our local newspapers, for instance, tend to spoil the student's taste for good English; later in life, as an engineer, his daily contact with illiterate men inclines him to careless speech and slovenly writing. As Brander Matthews says: "The uneducated are inclined to resent any speech more polished than their own."

* The University of California, where these lectures were delivered.

A distinguished engineer and veteran mine-manager, Arthur DeW. Foote, recently complained to me about the careless writing of the young men that applied to him, by letter, for professional employment. Most of these letters, he said, were so untidy in appearance and in expression that he threw them into the waste-paper basket; but, he added, whenever he received a letter neatly written and clearly expressed he gave it kindly consideration. He told me also that he had found it impossible to promote several bright young fellows on his staff because they did not know how to keep a legible record or how to use English intelligibly. "Such bad English; drummer's English!" he exclaimed. In the course of further conversation he recalled an interview with the late Professor Christy, of this university, who asked him to give an address to the mining students. "No," Mr. Foote replied, "the engineer is called upon to do everything but preach; from that he is excused." Christy then asked: "If you were to give a talk, what would be your subject?" Foote replied: "Writing; your students need to be taught that. I would not allow any of them to disfigure our mine-records." "But that," pleaded Christy, "is the business of the high-school." "They appear to shirk it," said Foote; "you ought to see that they don't get through the mining-school without some training in the writing of reports and technical papers."

The engineer graduates of this university are not peculiar in being unable to handle skilfully a tool that they must use as long as they live. In this respect many graduates of other technical colleges are equally deficient. A. S. Hill,* professor of rhetoric in Harvard University, has said: "Every year Harvard sends out men—some of them high scholars—whose manuscripts would disgrace a boy of 12; and yet the College can hardly be blamed, for she cannot be expected to conduct an infant-school for adults." The cure is for engineering colleges to refuse degrees to illiterate students or to those who show no regard for precision of language; meanwhile making an

* Whose 'Principles of Rhetoric' is a most useful textbook.

effort to remedy the defect by giving the necessary instruction.

There should be no need to lay stress upon the part that writing plays in an engineer's life. Until he accomplishes some notable work he is known to most other men only through his writings, in the form of letters, articles, and reports. In default of personal acquaintance, a man—particularly a young man with his reputation yet to make—is likely to be judged by his official letters. From the style of these, his correspondents infer the quality of his mind and the order of his method. The ability to write a terse report, to state facts plainly, and to convey information intelligibly wins instant respect for him and opens the door to wider opportunity. Similarly, an article contributed by an engineer to a technical periodical may mark him as well-informed, careful in observation, and accurate in statement. An agreeable and capable writer makes friends—even clients—of his readers. To be known honorably is capital.

My own experience shows that nicety of phrasing is regarded by many engineers as almost effeminate. Several of those whose writings I have revised would applaud the statement of a Denver editor that literary form is "a mere frill"; all that is needed, said he, is "to get there," that is, to say what you have to say in your own way, no matter how imperfectly, so long as you say it. This goes to the heart of the matter. You may, of course, make yourself intelligible even if you disregard many of the principles of the art—for writing is an art—but this lecture was not intended for those who are satisfied with such a performance. Although you may make yourself understood in some measure by following such a method—or lack of method—you cannot convey your ideas clearly, and fine distinctions of meaning will elude you completely. Furthermore, such writing will stamp you as uncultured, careless, and therefore not equipped for scientific work. The aim of all of us—not the Denver editor alone—is to "get there," that is, to accomplish our purpose. "For," as Hamlet says,

"every man has business and desire, such as it is." What then is the purpose of writing? It is to convey ideas: to tell what we have seen, what we think, what we believe. Language is a vehicle of expression; it was not intended for soliloquy; civilized man does not live by himself, nor does he talk to himself, except when he is drunk.

Assuming therefore that the purpose of writing is to convey ideas, and that ideas cannot be conveyed without adequate technique of utterance, let us consider how to attain effective expression. No one can attain it without care and without method, least of all when he is discussing technology or explaining matters requiring mental effort on the part of both the persons concerned, the writer and the reader. At best human speech is an inadequate vehicle of thought; much of the idea is lost in transit; the part that reaches its destination is travel-worn. Rarely does a thought impinge upon the reader's mind with quite the freshness and the vigor with which it issued from the brain of the writer. To expect to succeed without effort is childish, because it is contrary to experience; as if a farmer, going to market, were to put his potatoes, not in sacks, but loosely into a wagon that needed repair, and then should take any road that offered, driving without regard to ruts or stones, rapidly and recklessly—just to get there—with the result that many of the potatoes were thrown out of the wagon and those which survived the journey were so bruised as to be unfit for sale. Another farmer, with more sense, puts his potatoes into sacks, which are packed securely in a tight wagon, with axles well oiled and brake in good order. He selects the road that leads as directly as possible to his destination, driving carefully and avoiding obstacles, so as to deliver his potatoes speedily and safely at the nearest market, where they promptly fulfill his purpose. He "gets there" in the full meaning of the phrase; the other fellow fails. Henry James, in an address at Bryn Mawr, said: "There are in every quarter, in our social order, impurities of aggression and corruption in plenty; but there are none, I think, showing so unperturbed a face—wearing, I

should slangily say, if slang were permitted me here, so impudent a 'mug'—as the forces assembled to make you believe that no form of speech is provably better than another, and that just this matter of 'care' is an affront to the majesty of sovereign ignorance."

Before proceeding further I think it proper to say that I speak to you as an elder brother. Like some of you, I was trained to be a mining engineer and I practised my profession for 18 years, until I began to earn my living as a journalist, 15 years ago. It is as a technical writer that I address you, as one in sympathy with your profession and keenly aware of the importance of being able to write well. I have long been learning, and I am still learning by the application of the ideas and methods that I offer now for your guidance. I speak to you as a student, not as a master; as an amateur who has become a professional, not as a professor.

Having practised the art of writing for an essentially practical purpose, I understand the difficulty of it, and also the delight of doing it well occasionally. In my daily work as an editor, revising manuscript, I am often astonished to see how illiterate the scientific man can be, and how little of university culture clings to the engineer. For instance, he will commonly use the word 'data' as if it were of the singular number.

(1) "The data *is* [are] plentiful."

(2) "*Much* [many] data *is* [are] available."

(3) "It was not possible to obtain a value for WO_3 in scheelite from so *little* [few] data."

(4) "There will be *less* [fewer] data from which to make an estimate."*

(5) An officer of the U. S. Geological Survey says: "No data *is* [are] available concerning the supply of such material."

(6) A physicist of the U. S. Bureau of Mines says: "Data

* In the examples quoted to illustrate these lectures, the words that should be omitted, or to which critical attention is called, will be given in *italic*, and the words to be substituted will be placed between brackets.

pertaining to these condenser systems *is* assembled in Table III."

(7) A State Mineralogist writes: "The data *was* [were] obtained by making personal investigations "

A similar blunder is made with 'phenomenon.'

(8) A technical journal remarks: "Sir Oliver Lodge re-discovered the same phenomena and suggested *its* [their] application to purifying the atmosphere." It would be better to say, "and suggested that they be applied to the purification of the atmosphere."

(9) "Chemists have yet to agree upon the explanation of *much* [many] of the phenomena to be observed."

(10) "The use of rods, instead of balls, as a grinding media."

Perhaps, as Landor suggested, we ought to anglicize such Latin or Greek words and write datums, stratums, phenomenons, as we write factotums and ultimatum, without apologizing. Indeed, one thoroughly capable metallurgist objected to an editorial correction of this solecism. If a university graduate does not know that 'data' is the plural of 'datum,' he is no better informed than the miner who speaks of "them quartz" or of "stratas that prospect." An engineer wrote to me about the "foliae" of the schist in Rhodesia. The plural of *folium*, of course, is *folia*. Those who make such blunders also write about the "ration" of 10:1 and "the Seward peninsular."

You may say that these blunders arise from ignorance of Latin, but this is not the whole truth; they come from ignoring good usage, and from reading an illiterate daily press. The editor of the San Francisco 'Chronicle' writes: "Armed with *this* data, the U-boats have crossed the Atlantic to find a more fruitful field for their operations." The editor of the 'Examiner' says: "Data *is* being gathered on intensive farming." It may not be necessary to be a classical scholar in order to write good English—such as John Bright spoke—but I believe it true that some knowledge of Latin and Greek is necessary to an intimate understanding of English, particularly that part of it which deals with technical science, the terms of which are

so largely derived from the classical languages. Most of our Anglo-Saxon words have been so long used to describe the every-day affairs of life, and to convey simple ideas, that they carry connotations unfitting them to express the new concepts of science and the precise ideas of technology. Our civilization came from the Mediterranean; our literature came through Bede, not Beowulf; through the songs of Provence, not the sagas of Schleswig. I submit to you that the Anglo-Saxon tradition has been over-done; the renaissance of learning began in Italy and its voice was Latin.* It speaks in the two classics of English literature, the King James version of the Bible and the plays of Shakespeare. Nearly two-thirds of the words in the English language are of Latin derivation. I do not refer to colloquial language, but to literature. The idea that the purity and simplicity of our literature depend upon the use of words of Anglo-Saxon origin is based upon a fallacy. In the foregoing sentence "word" is Anglo-Saxon, "idea" is Greek, but "purity," "simplicity," "literature," "depend," "use," "origin," "based," and "fallacy" are all from the Latin. These are the principal words; the grammatical links, of course, are Anglo-Saxon, which is the matrix of English.

Since the advancement of science in the Victorian period, the vocabulary of technology has grown rapidly, borrowing words from the languages of ancient learning, so that now a scientific man can hardly speak or write intelligently without knowing the derivation of the terms he is compelled to use. Do not use words unless you know their meaning. If your classics were skimmed at school, study the dictionary;† above all, read the best writings. "Imitation is the sincerest flattery." There is a good deal of what Marion Crawford called "the everlasting monkey" in man. That reminds me of Stevenson's phrase "sedulous aping." He recommended the imitation of good writers for the sake of acquiring style, and described how he

* 'The Art of Writing,' by Sir Arthur Quiller-Couch. Lectures VIII and IX.

† 'The Concise Oxford Dictionary' can be bought for one dollar.

himself learned to write while a student at Edinburgh, by imitating passages from Macaulay for a month, then copying Froude for another month, then Carlyle, and so on; thereby attaining the felicity of expression for which he became famous. But, be it noted, Stevenson did this for practice only; it did not prevent him from acquiring a style all his own, because he did not subject himself intellectually to another writer by setting him up as an idol.

If so many of our young engineers write uncouthly, it is because they read so little good literature. The time given to the piffle of the press is lamentable. Our grandfathers used to read the Bible daily; we read the daily newspaper. Even the magazines rarely furnish safe models of writing, and the ordinary textbook is but the dry bones of a great art. If you would absorb style subconsciously read Huxley's essays and Froude's short studies; read Ruskin and Stevenson; read Defoe's 'Robinson Crusoe' again and Darwin's 'Voyage of the Beagle'; read Washington Irving's 'Alhambra' and John Muir's 'Climbing the Sierras'; but in order to appreciate such books, and learn from them, you must read intensively—the kind of reading that learns its lesson when done once, and once only.

Of style it is too early to speak, "yet the man of science ought best to know that style and matter can no more be dissociated than skin and bone. In scientific prose words should be used as symbols in mathematics."* Our first aim is to be understood. The art of writing is based on scientific method. Science is organized common sense. A blunder—made not infrequently even by scientific men—is to assume that good writing is extrinsic to its subject. On the contrary, "science and literature are not two things, but two sides of the same thing." Huxley said that; and he illustrated his own maxim, so that his writings became as glimpses of the obvious and his lectures as windows into the infinite. Science, I repeat, is not

* Sir Clifford Allbutt, whose 'Notes on the Composition of Scientific Papers' can be heartily recommended to the technical student.

divorced from literature, and no valid reason exists why technology should be regarded as if it were legally separated from good English. Technical writing is the precise expression of special knowledge. The information of the average man is like a turbid solution, the technology of an engineer is like a clean precipitate; the one is amorphous, the other crystalline.

“The development of the mind is an advance from the indefinite to the definite.” The technical man in his processes, whether of the mill and mine, or in the reducing operations of his own mind, follows a similar line of action. His constant effort is to distinguish between what he knows and what he thinks he knows, between fact and fancy, between observation at first-hand and information at second-hand. When he begins to place himself on record, he should follow the same mental process, but with a difference: in his technical operations he deals with insentient matter; in his technical writing he must keep in mind the human element; for he is recording himself not in the sand of the sea-shore, but on paper to be read and criticized by his fellows. Thus I come to a fundamental rule: REMEMBER THE READER. The Denver editor, who was contemptuous of the effort to write well, ignored this rule. Spencer, who studied style as an adjunct to philosophy, said: “The good instructor is one in whom nature or discipline has produced what we may call intellectual sympathy—such an insight into another’s mental state as is needed rightly to adjust the sequence of ideas to be communicated.” If you wish to communicate ideas, you must think of the other fellow, of the man at the other end of the line of mental communication represented by your writing. Thus, in order to be effective, you must be sympathetic; you will spare the reader doubt as to the meaning of what you have written, perplexity caused by the turgidity of your style, annoyance at the queerness of your terms, and weariness due to verbosity. You will communicate what you wish to say in language involving the least trouble to the reader. Some trouble he himself must take; for he also must be sympathetic and willing to expend his brain-tissue. Avoid tres-

passing on his patience. "Those are the most effective modes of expression which absorb the smallest amount of the recipient's attention in interpreting the symbols of thought, leaving the greatest amount for the thought itself." So said Spencer. This is the first great principle of writing: economy of mental effort on the part of the reader. Put yourself in his place, I repeat; if you do so sincerely, you will avoid most of the errors that prevent language from becoming pictorial and that retard the transmission of thought.

I spoke just now of economizing the mental effort of the reader. The writer can achieve that only by being willing to take pains himself. If you read a technical article, for example, and find that you understand it easily and comfortably, obtaining useful information without undue mental fatigue, you may rest assured that somebody else has taken trouble over the article and thereby spared you the labor of probing his meaning. Either the author has made an effort to be understood, or the editor has corrected and revised the manuscript so as to make the rough places smooth. Somebody must put hard work into every technical article that is written for publication; if not the author, then the editor; if both the author and the editor shirk their duty, the reader will have a headache. Therefore, **REMEMBER THE READER.** As Allbutt says: "A writer who writes to convince and not merely to see his name in print must learn to lay his mind alongside that of his reader."

The next desirable thing is to have a reader worthy of respect, so as to stimulate you to honorable effort. Most of the letters, reports, or articles that the engineer is called upon to write are addressed to persons whom he respects. I assume therefore that you are writing to somebody or to some group of persons to whom you wish to convey technical information or scientific opinions effectively and pleasantly. To accomplish this purpose your writing must be natural, clear, precise, and convincing.

II. NATURALNESS.

The key-note of good writing, as of good manners, is *B natural*. Sincerity is the first requisite for effective writing. When a man says what he knows or believes, he is likely to be interesting, because each human being possesses an individuality, a point of view, or a range of sympathy that makes him different from his fellows. To say or to write what you do not think, for the mere sake of talking or writing, is a cerebral exercise that must be performed with extraordinary skill if it is to be attractive. Affectations are rarely attractive, rarely effective. To be natural is to be yourself, not a *poseur*; to give the reader the best of yourself, instead of re-warming the baked-meats of yesterday. Quotations—which are second-hand thoughts—will serve occasionally when the thing you want to say has been said so well by another that it would be waste of energy to try to say it better; but, as a rule, the utterance of the writer himself is more interesting than the quotation, because the writer brings something of himself to bear on the subject and for the moment is more in touch with the reader than any dear departed author. Therefore, say things as best you can in your own way, neither in borrowed words nor in the phraseology that mimics another. Write as if you were speaking to a person whom you are anxious to persuade or convince. You will then write better than you speak, because, in the first place, you can be more deliberate, and secondly, you can revise what you have written.

Speaking and writing are similar mental acts, with a difference: the difference between eating food raw and eating it cooked. Some kinds of food gain nothing by being cooked; likewise some kinds of utterance are not bettered by being written down first; but most expressions of thought, especially

those that deal with complex ideas, must undergo preparation before they may be digested comfortably. The transactions of engineering societies are overburdened with half-baked chunks of knowledge that provoke mental dyspepsia. How palatable, on the other hand, is the carefully prepared article that has been seasoned with Attic salt, served with a *sauce piquante*, and dressed with the parsley of pleasant fancy—like the writings of Rossiter Raymond or of Clarence King.

Composition, however, is less natural than speaking. The pen or the pencil intervenes between the thought and the expression, introducing an element of artificiality, as well as one of deliberation. The spoken word cannot be recalled: the written word can be erased. Yet it is unwise to criticize your writing as it proceeds, for such self-criticism tends to embarrassment or self-consciousness. Revise the work carefully after it is done, not before, so as to avoid chilling the warmth of composition by cold analysis. You have heard of the centipede that was too much aware of his many legs, and became hopelessly entangled. Inopportune self-criticism will cripple writing, just as self-consciousness prevents most men from becoming satisfactory after-dinner speakers.

To be natural in writing, you must have something to say: something concerning which you feel impelled to write. To have something to say is the first requisite for effective speaking or writing. Most speeches and many writings are ineffective, if not worse, because, like an unhappy golfer, the speaker or writer does not see the object of his aim; he does not "keep his eye on the ball." Wait until you have something definite to tell. Only a fool talks for the sake of talking; that is why so many speeches fall flat. It is unnatural for a man to write for the sake of exercising his index finger and thumb; that is why so much writing is a weariness of the flesh. Make sure that you have something to say; then say it; and when you have said it, stop. "The best spoke in the wheel is the fittest, not the longest."

The story is told that President Wilson, when a boy, used

to read to his father whatever he wrote. Whereupon his father would ask, "What do you mean by that?" He would explain. "Then write it," was the advice. If, after writing something, you ask yourself 'What do I mean?' you may discover that you have not written what you meant to say.

The student while at college, and for some time afterward, is occupied mainly with the effort to acquire knowledge. To write is to convey information to others, which is the reverse of the normal youthful attitude; it involves a pose difficult to assume gracefully or effectively without practice; but such practice should be encouraged, because the effort to record thought involves the mobilization and marshalling of ideas, a disciplinary effort highly beneficial to the student's mind. Therefore it were well if some exercise in writing could be taken during the early process of acquiring knowledge.

To write naturally, you must exercise the faculty of writing until it becomes flexible and strong. The best way to learn how to swim is to plunge into the water. Most of those who write well have written a good deal, but you may be sure that they have not published all of it. Do your preliminary cantering in the paddock, not on the racecourse. The good writers obtained their reputation by being wise enough to keep their preliminary trials to themselves; meanwhile they noted the results obtained from the methods used by others. Ben Jonson said, "For a man to write well there are three necessities: to read the best authors, observe the best speakers, and much exercise of his own style." Naturalness comes from exercise, not from lack of care.

Aristotle said, long ago: "Naturalness is persuasive and artificiality the reverse; for people take offence at an artificial speaker, as if he were practising a design upon them, in the same way as they take offence at mixed wines."*

Some technical writers, aiming to be natural, succeed only in being sloppy.

(1) "If it is inconvenient to keep the *muck* [waste rock]

* "The Rhetoric of Aristotle". Translated by J. E. C. Welldon, 1886.

drawn off, tap the *dirt-way* [ore-chute] a few feet up, on the opposite side of the man-way."

The writer is describing a method of mining and uses the language of an uneducated laborer, perhaps with the idea that it sounds 'practical.' Here are two more examples:

(2) "With the *advent* [completion] of the new mill, which has a capacity of over 100 tons per day, the haulage problem becomes *one for careful consideration* [important]."

'Advent' means the season before the Nativity; it is also used when referring to an important arrival, not the starting of a stamp-mill. The last sentence in the quotation exemplifies the use of an abstract phrase instead of a concrete word. The language is 'natural' to a semi-literate promoter but not to an educated engineer. Do not mistake vulgarity for ease, nor inaccuracy for freedom.

(3) "The process is said to have done such satisfactory work that other *plants* [operators] have been *contemplating* [considering] the *installation* [adoption] of the *process* [it]."

This also illustrates an uncouthness that simulates naturalness. The writer, a graduate of a university, has fallen into the style of those about him in a mining community. The 'contemplation' of plans, the 'installation' of plants, the 'inauguration' of methods, and the 'prosecution' of developments are the stock-in-trade of local reporters and of the equally illiterate persons that play the mining 'game' on the frontiers of industry. The imitation of them should be beneath an educated engineer.

Young men, when about to describe a mine or explain a metallurgical process, are prone to start with the idea that they must indulge in 'fine' writing; meaning thereby a style pitched several tones higher than is habitual to them. When they prepare matter that is to be printed, they affect a vocabulary and a phraseology foreign to them; like the queer persons that have 'society' manners as distinguished from their behavior at home. There are public occasions, of course, when an added dignity of bearing is befitting. For similar reasons, it is proper

that the irresponsibility and ease of ordinary talk should give place to deliberate thoughtfulness when one is making a business statement or preparing matter for print; but the extra effort should not entail a pomposity that smothers the subject in verbiage. The attempt to write in a key higher than that of conversation need not provoke insincerity or affectation. It requires only more care and more deliberation. Write as if you were addressing an honored senior in your own profession to whom you desire to convey information; do not try to impress him with your skill as a stylist, but make yourself perfectly clear, so that he may have the benefit of any facts or ideas that you can place at his service. As a warning, I quote the following description of the Mount Morgan lode, in Australia:

(4) "It may be considered as consisting of a network of veins, traversing on the one hand a metamorphic matrix of a somewhat argillo-arenaceous composition and on the other hand what appears to be a feldspathic tufaceous igneous rock."

This is metamorphosed English pseudomorphic after flappedoodle. Much of the geologic description that poses as profundity is rhetorical rot. Similarly the technical terms needlessly used by half-educated writers remind one "of the French that is spoken by those who do not speak French."

A Tasmanian geologist described an ore deposit as due to "the effects of a reduction in temperature of the hitherto liquefied hydro-plutonic solutions, and their consequent regular precipitation. These ascended in the form of metallic superheated vapors which combined eventually with ebullient steam to form other aqueous solutions, causing geyser-like discharges at the surface, aided by subterranean and irrepressible pressure." What can you make of this "geyser-like discharge" of language? You will find, if you take the trouble to translate the pretentious terms, that the description conveys a minimum of information with a maximum of sound: "Full of sound and fury, signifying nothing;" or, as Ruskin has said, "Great part of the supposed scientific knowledge of the day is

simply bad English, and vanishes the moment you translate it."

Here is another sentence written by a young man who also mistook sound for sense:

(5) "Since the installation of their air-compressor, a new campaign of development has been inaugurated, operations have been extensively prosecuted, more particularly in the Carboniferous limestone, which is usually so prolific of values, due to the well recognized leaching of mineral solutions emanating from the plutonic magma."

Many of these words are out of place; a bishop is installed, a president is inaugurated, a criminal is prosecuted, a rabbit is prolific. Incidentally, it may be noted that the water that leached the limestone probably came from above, not from below; originating in rain-fall, not from the depths. These grandiose words, being inappropriate, fail to convey a definite meaning; they only make a confusing noise. Probably he meant to say:

"The use of the new compressor has greatly expedited operations, particularly in the Carboniferous limestone, which has been enriched by mineral solutions."

This, however, is not satisfactory, because the sentence contains discrete ideas, wholly unrelated; therefore they should be separated, thus:

"The use of the new compressor has greatly expedited operations, particularly in the Carboniferous limestone. This is important, because the limestone has been enriched by mineral solutions and therefore is a likely place to find ore."

Samuel Johnson exclaimed: "Witness the immense pomposity of sesquipedalian verbiage;" and we know how he himself sinned in that way. George Meredith, a master of words, recorded his objection to "conversing in tokens not standard coin," which is what 'prosecute,' 'install,' and 'prolific' are in such a context; they are not legal tender in the forum of technology; they are like Canadian quarters, British shillings, or French francs tendered to a merchant at Chicago or Denver,

legal though they be at Montreal, Manchester, or Marseilles. As you know, I hold that the use of words of Latin origin, usually of more than one syllable, is helpful, if not indeed unavoidable in expressing ideas current in technology, but writing becomes incoherent when words are used because of their sound rather than their sense. Such usage bespeaks a snobbishness of mind, the aping of erudition, a mere pretence. If a man knows what a thing really is, he describes it as black or white; if he does not know what it is, he masks his ignorance by saying in long words that it partakes of the general quality of grayness. The young writers who clothe meagre observation in elaborate words soon fall into the habit of using terms that they do not understand, and therefore fail to make themselves understood, if indeed they do not convey information that is positively false. The employment of words that are unfamiliar to the writer, and that therefore are inconsistent with his own way of saying things, serves but to cripple his power of expression. He may get into a tangle by dragging strange words from afar. When he does find himself thus entangled he should cut loose, stating things in his own way, that is, in plain words that he understands thoroughly. Again I say: REMEMBER THE READER. If you do, you will win respect as a writer. The man with only a smattering of his subject splashes all over it with words of learned sound and unlearned meaning, because the ability to make such a noise is more easily acquired than the reality of knowledge. Huxley said that if a man really knows his subject, "he will be able to speak of it in an easy language and with the completeness of conviction with which he talks of an every-day matter. If he does not, he will be afraid to wander beyond the limits of the technical phraseology which he has got up."* In his lectures to working-men Huxley showed how the fundamental truths of science could be stated in the simplest and most illuminating speech, without loss of accuracy. Indeed, the ability to

* The concluding phrase illustrates how a great writer may lapse into poor English.

explain scientific or technical matters to the unlearned is a test of the thoroughness of a teacher's understanding of his subject. If, for example, you care to test your grasp of engineering or of geology, try to impart what you know to a younger brother or sister. That is a good test of your understanding and of your use of language.

III. CLEARNESS.

The notion prevails that writing is a knack: that the skilful use of the pen is a gift of nature. This is an error. Dogberry may be responsible for it; he said: "To be a well-informed man is the gift of fortune, but to write and read comes by nature." Since Dogberry said it, we may be sure that Shakespeare thought otherwise. Ability of any sort may be partly innate, but my own observation and experience lead me to conclude that most of the easy writers have become so by constant practice. As I recall those who have won reputations with their pens, I remember that most of them have written a great deal and have taken particular pains to improve their style. The suggestion that proficiency in the difficult art is a happy accident calls forth an ironic smile. The larger part of the great writing in our literature is the result of persistent effort. An easy fluency has been the undoing of many; their flamboyant and fantastic scribbling has proved as perishable as froth.

This criticism applies to technical writing also; in order that a technical description or discussion may hold the interest of the reader, at least long enough to cause him to read it to the end, the writing must be done carefully and systematically; otherwise it will fail in its purpose of conveying information. Clearness is absolutely essential. "It is not enough to use language that *may* be understood; it is necessary to use language that *must* be understood."*

From first to last, REMEMBER THE READER: that is a rule never to be forgotten in any kind of writing except the diary. The diarist can shoot his words into the air; yours are aimed at the intelligence of a sympathetic human being. Consider him; if you do, you will escape half the pitfalls awaiting you.

* Quoted by Hill from Quintilian.

Clearness of statement depends, first, on the choice of words; next, on the order in which they are arranged; then, on the sequence of clauses composing a sentence; and, finally, on the arrangement of sentences in a paragraph.

Select the word that is appropriate to your thought: the word that pertains to the thing described.

Food is wholesome; climate is healthful; a person is healthy.

A foundation is permanent; an orebody is persistent.

A climate is equable; a contract is equitable.

Judgment is held in suspense; sediment, in suspension.

A problem is unsolvable; a mineral, insoluble.

The force of steam was discovered; the steamboat was invented.

We measure distance in linear feet, but pedigree by lineal descent.

Good writing depends not so much upon a large vocabulary as upon the choice of words. The wrong word derails the thought; the needless word is an obstruction. A writer who flings needless words about him is like a swimmer who splashes; neither makes speed. The blue pencil of the editor is the symbol of amputation because we recognize that it removes the useless members of the literary structure. Revision commonly denotes pruning. The dominant fault of the incapable writer is the employment of too many words. Even practised writers err in this respect; for example, H. G. Wells is fond of doubling his adjectives, thus:

(1) "In the preceding chapters there has been developed, in a *clumsy, laborious* way, a *smudgy, imperfect* picture."

More than one adjective may be needed to describe an object, but each adjective should have a distinct meaning. Whether the adjectives in "smudgy, imperfect picture" overlap may be questioned. The proper use of adjectives and the use of proper adjectives can be studied profitably by any writer, however experienced.

Verbosity is a sign either of carelessness or of lack of time for proper care. Pliny wrote to a friend, nearly 1900 years

ago, "I have not time to write you a short letter, therefore I have written you a long one."

Avoid words you do not know fore and aft. Don't be tempted into the use of high-sounding terms that may serve to cover ignorance. Comprehensive words like 'development' and 'evolution' are often mere noise and smoke, not penetrating shot. As the old lady was grateful for "that blessed word 'Mesopotamia'," so that comfortable word 'metasomatic' has cloaked many nebulous notions of ore deposition. Likewise 'dynamic' is sadly overworked by perplexed geologists.

(2) "The *dynamic* power that shattered the mountains and created fissures in which the ore is now found."

So far as is indicated, the "power" might have been dynamite. It is amusing to recall how Ruskin twitted Tyndall for a similar indiscretion. Tyndall had referred to a certain theory, which was in debate, affirming that it, and the like of it, was a "dynamic power which operates against intellectual stagnation." Whereupon Ruskin commented thus: "How a dynamic power differs from an undynamic one, and, presumably, also, a potestatic dynamis from an unpotestatic one—and how much more scientific it is to say, instead of—that our spoon stirs our porridge—that it 'operates against the stagnation of our porridge', Professor Tyndall trusts the reader to recognize with admiration."

If you do not know how to characterize something you have seen, do not imagine you have done your duty when you have labeled it a 'phenomenon'. That is a generic term conveying to the scientific mind the idea of an observed fact, especially with relation to what is subject to change, as opposed to the essence of things; in a loose and popular acceptance it carries an impression of the unfamiliar; in either case the label 'phenomenon' explains nothing. Macaulay said: "I have often observed that a fine Greek compound is an excellent substitute for a reason."

In a recent controversy* a clever technician had much to

* Trans. Inst. M. and M., London, Vol. XXIV, page 178.

say about "orogenic" when discussing the source of ore in veins. He made bold to play with it for awhile, but Greek terms, like razors, are not to be flourished recklessly. He had to be told that *'opos* means mountain and that 'orogenic' relates to mountain-making, not to the genesis of ore. Be warned therefore: know what words denote before you use them.

The rule is to use the word that will be understood by the reader and that at the same time expresses the meaning best. "Too many cooks spoil the broth" is a simple statement, which 'Punch' transformed jocularly into "A superfluity of culinary assistance is apt to exercise a detrimental effect upon the *consommé*." That is the language of a newspaper reporter.

Avoid using words of similar sound, but of different meaning, in the same context.

(3) When preparing this lecture I wrote: "By the *way*, I must ask you not to *weigh* the value of my admonitions entirely by the manner in which they are conveyed to you." Noticing the similar sound of 'way' and 'weigh', I deleted the introductory clause.

(4) "The main whistle answers with two long *blasts*, thus notifying all the men on the hill that the *blasting* is over." Substitute 'calls' for "blasts."

(5) "The requirement from the *management* [managers] of reports to stockholders, giving a detailed account of their stewardship, will *be corrective of* [correct] many of the abuses of *management* [corporate responsibility]."

(6) "The proportion of the rainfall that sinks into the ground *naturally* varies according to the character of the underlying rocks. But, whatsoever the *nature* of the rocks may be, they are etc."

This was written by a geologist pre-eminent for good writing—James Geikie. The "naturally" does not refer to 'nature', it means 'obviously' or 'necessarily'.

(7) A hydrographer writes: "This is *well* illustrated by *well* records."

(8) "In the *description* of many of the localities *described*."

(9) "The problem is not simple. The best *solution* would be to roast the ore carefully, forming a silver sulphate, which is *soluble* in hot water."

(10) "The first light on *the solution* of the problem was the discovery that the gold was *soluble* in a *solution* of an alkaline mono-sulphide." The first phrase italicized can be deleted; and to prevent the awkwardness of using 'soluble' with 'solution', it would be an agreeable change to write that "the gold dissolves in a solution of an alkaline mono-sulphide."

When writing concerning a chemical solution, do not refer in the same paragraph to the solution of the problem; likewise, when writing on geology, do not, in the same context, refer to the rock formation and to the formation of the ore deposit. The use of a word in different senses causes confusion of thought in the mind of the reader.

(11) "The guides were held so strongly by the heavy mass of *unset* [moist] concrete that the jar from passing skips only *settled* [fixed] them more firmly into place, and the initial *set* was not broken."

He may mean the 'set', or hardening, of the cement, but as he is writing concerning shaft-work, he may be referring to a 'set', or structure, of timber; therefore he should insert 'of the concrete', or 'of timber', to explain. This use of 'unset', 'settled', and 'set' in the same context is bewildering.

(12) "This spherical shape can be maintained *only* if the pressure on the inside is greater than without. Surface-tension *only* can account for this excess."

Here 'only' is used twice and with different meanings. The second one should be replaced by 'alone'. The first sentence can be improved thus.

"The spherical shape cannot be maintained unless the pressure &c."

(13) "A loose *knot* is one *not* held firmly in place."

(14) "The *ore*, or the vein itself even, is hard to trace."

(15) "This machine is preferable *for* the *four* reasons already indicated."

Oliver Wendell Holmes said: "People that make puns are like wanton boys that put coppers on the railroad-tracks."

When you use a word that has more than one meaning, make clear the sense in which you are using it, by the context or by an explanation. Of two words that may be employed in the same sense, select the one susceptible of a single interpretation.

(16) "He prepared a *partial* account of the events that preceded the strike." Was his account prejudiced or was it only incomplete?

(17) "This required *the partial* [part of the] time of a man who might be *using this time* [employed] to better advantage."

(18) "Sometimes *partially* [partly] formed pyrite crystals have barite between them, and the galena crystals are *partial* [incomplete] and enclose some barite."

(19) The 'New Republic' says, "In order to justify the sternness of the protest the case itself should be at least *partially* established." Cases may be established partially, that is, with partiality. The editor meant 'in part' or 'partly'.

(20) "The work described herein forms part of a *partially completed* [an uncompleted] study of sulphur di-oxide."

A 'partially' completed work may be one that is complete in part or one that is generally unfinished.

(21) "It is impossible to *amalgamate* coal-tar thoroughly with the pulp in the agitating-tank."

In milling, 'amalgamate' refers to the combination of mercury with one or both of the precious metals. To use this term as a synonym for 'mix intimately' or 'emulsify' is bewildering.

(22) "John W. Smith, the *late* manager of the Wild-Cat mine, was unable to make it pay."

Is Mr. Smith dead? Was he the former or was he the deceased manager? Or was he merely unpunctual? If he was alive when the sentence was written—and he was—he should have been described as "lately [or recently] the manager".

Avoid needless indirection, as by using a double negative.

(23) "The details of the methods used abroad are *not unknown* to American chemists."

He proceeds to state that they are thoroughly known.

(24) "The *inefficiency* [efficiency] of labor at these mines has *increased* [decreased] very little."

The affirmative is preferable to the indirect negative, for example:

(25) "In this part of Mexico the vitreous type of rhyolite is *not uncommon* [common]."

(26) "There is no reason to believe that the mine is as rich as represented."

"There is reason to believe that the mine is less rich than represented."

Possibly the ore was such as to render mining unprofitable, then "less rich" should give place to 'poorer'.

The choice of the right article is important.

(27) "Reduce the loss in the residue to *a* [the] minimum."

He said 'a' as an elegant variation on 'the', which he had used twice just before, but the use of 'a' before minimum suggests that he did not know what was *the* minimum attainable.

(28) "I used *a* process in which manganese oxide serves as purifier of the electrolyte."

He means: "I used the process in which manganese oxide serves to purify the electrolyte." It was a particular process, well known to those interested in the subject—that of refining copper.

(29) "He used *the* method that he had learned while at Broken Hill, in Australia."

The 'method' is not explained or described; it remains 'a method'; therefore 'a' should replace 'the'; otherwise his readers are likely to be puzzled.

Do not confuse time with place. For example:

(30) "The ore *sometimes* [in places] has a distinctly banded structure."

(31) "Such ore deposits are of *frequent occurrence* [numerous or of common occurrence] in Nevada."

(32) "This kind of ore is *frequently met with* in Colorado."

One does not 'meet' ore either once or many times; the sentence should read:

"This kind of ore is found in many mines in Colorado."

(33) "Meta-cinnabarite is not a *very* common mineral, and *when* [where] it *does occur* [is found] there is usually some cinnabar *with it*."

Delete 'very' and 'with it', thus placing 'meta-cinnabarite' and 'cinnabar' in emphatic positions at the beginning and end, respectively, of the sentence.

(34) "The pyrite outcrop is *always* [everywhere] oxidized."

(35) "These crystals are *sometimes* [in spots] as much as an inch in diameter."

(36) "Richer ore is invariably found *when* [where] the lodes are in the sandstone."

(37) "*At times* [in places] the vein pinches to a mere thread."

(38) "The vein *when* [where] it is thickest breaks into small stringers."

The use of the correct adverbial phrase is more descriptive, it evokes the correct image and thereby fulfills the purpose of language.

(39) "This coal has been measured *in several instances* [at several points or in several places]."

(40) "True conglomerate was observed *on rare occasions* [rarely or at points widely separated]."

(41) "Only *part of the time* [in places] will erosion expose the formation for our study."

(42) "The formation in which the deposits occur is hornblende-schist, which near the surface is *often* [in several places] altered to chlorite-schist."

The introductory clause is not commendable; he is speaking of one ore deposit; he uses the plural unnecessarily, and employs that tiresome word 'occur'. He means to say that the 'ore-bearing rock', or the 'rock enclosing the ore deposit', is hornblende-schist.

(43) "*When* [where] the cost of sulphuric acid is high, and

where the quantity of shale to be retorted is small, *then* [there] *and in such case* it is possible that the probable financial results would not warrant the expenditure of capital required to construct the plant for the manufacture of the ammonium sulphate."

It is not a question of time but of place; he is referring to the exploitation of shale in remote localities. "And in such case" is redundant; it is a mere frill. So also are the words "it is possible that". He means that where sundry conditions prevail there "the financial result probably would not warrant the expenditure."

(44) "The rich veins diminish *often* in richness as depth is gained."

If they diminish "often" they must soon be done to a frazzle. It does not require a Byzantine logothete to inform the student that the adverb must be put as near as possible to the word it modifies. Here 'often' modifies 'diminish' and it might precede that verb, but, more truly, 'often' modifies the whole statement and it would be better to say "Often the veins diminish in richness as depth is gained." But he does not mean 'often'; he means that 'many' or 'most' of the veins become impoverished with increase of depth, and he ought to say so.

As the stage reeled close to the edge of the precipice the timid passenger asked the driver, "Do people *often* fall over the edge here?" "No", said the driver, "only once."

(45) "These rocks are *nearly always* red."

"Most of these rocks are red."

(46) "These pebbles are *almost never* striated."

"Few of these pebbles are striated," or "Only a few of the pebbles are striated."

(47) "The rock contains *much* altered plagioclase." He means not a large proportion of altered plagioclase but much-altered or greatly altered plagioclase.*

* From G. M. Wood's 'The Principal Faults Found in Manuscripts Submitted for Publication by Members of the United States Geological Survey.' 1907.

'Where' is used awkwardly when not referring to place:

(48) "I gave another tabulation *where* the addition of lime has a marked retarding effect on the *slime settlement*."

Substitute 'showing that' for 'where', and use 'settling of slime' at the close.

Do not hesitate to define a term the meaning of which may be doubted. When you do so, avoid the use of terms that themselves need to be explained. As Samuel Johnson said: "To explain, requires the use of terms less abstruse than that which is to be explained, and such terms cannot always be 'found. For as nothing can be proved but by supposing something intuitively known, and evident without proof, so nothing can be defined but by the use of words too plain to admit of definition."

Dr. Johnson sinned grossly against his own precept; for example, he defined a 'network' as "that which is reticulated or decussated at equal distances with interstices between the intersections." A fisherman, when a witness in court, defined a net as "little square holes with string tied around them."

Dean Swift defined an archdeacon as "a man who performed archidiaconal functions." Which left things worse than ever.

Do not define in terms that need to be defined; do not spare definitions. Many technical articles lead nowhere simply because the writer has not made it clear whither he is driving. To discuss the persistence of ore in depth, for example, is hopeless unless the principal terms, 'ore' and 'depth', are defined. Definitions tend to clear the thought of the writer just as they clarify the understanding of the reader.

IV. PRECISION.

“The chief aim in style ought to be absolute precision”, said Flaubert. “There is only one noun that can express your idea, only one verb that can set that idea in motion, and only one adjective that is the proper epithet for that noun.” Let this be your motto. The engineer aims to be exact in all his measurements; he should measure his language with similar exactness. The technical term is a word of precision. It is not only precise, it is a word-saver. To the unscientific the earth is “a ball slightly flattened at the poles, something like an orange”. To the scientific it is “an oblate spheroid”. A similar contrast between the precision of the technical term and the vagueness of common words is afforded by a conversation between Ivanhoe and Rebecca:

“‘What device does he bear in his shield?’ asked Ivanhoe.

‘Something resembling a bar of iron, and a padlock painted blue on a black shield.’

‘A fetterlock and shacklebolt azure’, said Ivanhoe”—using the technical terms of heraldry.

It is good style in writing, however, to adapt your manner of expression to the intelligence and experience of the person or persons to whom the writing is addressed. The description of a mine should be worded differently according as it is intended to inform a mining engineer, a director, or a bishop. **REMEMBER THE READER.**

It is as incorrect to write in a technical way for a non-technical reader as to write in a popular way for a technical or scientific reader. That is the best style which enables the writer to place himself in the closest mental touch with his reader, to establish a maximum of sympathetic understanding. Let your precision be proportioned to your accuracy. You should not try to be precise in matters that do not admit of accuracy,

any more than you should be vague in matters that require exactness. The technical writer must be sincere. Sincerity is the first essential of all good work. It is absurd to state the average value of the ore in a gold mine to three places of decimals of a pennyweight, or its equivalent in money, because no sampling and assaying can be done so accurately as to give results trustworthy within limits so narrow.

The engineer for the Globe & Phoenix mine in Rhodesia, for example, stated the average assay-value of the gold ore in that mine on June 30, 1910, at 32.259 dwt. per ton. The three decimals were only a florid decoration. The same engineer gave the total tonnage of the ore as 174,788. The last three figures signified nothing; they were only an arithmetical frill. He could not ascertain the average gold content within half a pennyweight per ton, nor could he estimate the available tonnage of ore within a thousand tons. The sequel proved that even these limits of accuracy were beyond his skill.

Another engineer gave the average value of the gold content of the ground to be dredged on the Natomas property, in California, to four decimals of a cent per cubic yard. On January 1, 1909, he estimated a yardage of 342,995,536 and a gross yield of 9.9395 cents per cubic yard. In each set of figures the last three were merely pretentious. Such meticulous precision is an impertinence to the profession; it is an imposition on the shareholders. The estimate was wrong by several million dollars.

Do not express a forecast in terms of history nor an approximation in terms of measurement. In short, in writing a technical report, remember that good style calls for sincerity. As elaborate precision of statement is out of place in an inexact generalization, so also beauty of phrasing may defeat the purpose of writing if it be intended to accomplish a non-æsthetic purpose. Ruskin wrote so exquisitely that people missed the moral of his utterance in the enjoyment of his assonant periods. He recognized the fact too late and expressed his regret. In a lecture on 'The Mystery of Life', in 1868,

he said: "For I have had what in many respects I boldly call the misfortune to set my words sometimes prettily together; not without a foolish vanity in the poor knack of doing so; until I was heavily punished for this pride by finding that many people thought of the words only and cared nothing for their meaning."

Suit the style to the purpose; fitness is the essence of good taste.

Words like 'percentage' are terms of precision; so are decimals; they should not be used in making approximations or rough estimates.

(1) "The operation will take *about* 1.5 hours."

The statement is an approximation and should read:

"The operation will take about an hour and a half."

(2) "About 50% [half] of the old hands returned each season."

(3) "The tailings from the vanners consist of approximately 75% sands and 25% slimes."

To say '75%' is not an approximation; it is a precise statement, not warranted in this instance. Note the unnecessary plurals.

"The tailing from the vanners consists of three parts sand and one part slime."

(4) "This increased the *percentage* [proportion] of colloids in the flotation cell."

(5) "A large *per cent* [part] of the oil lost will probably be recovered."

The word 'percentage' should not be used without reference to exact figures; it is a term of precision and should not be employed recklessly.

(6) "The underflow has a specific gravity of 1500."

Do not use zeros where they are meaningless. He wrote 1.500 instead of 1.5, and the type-setter did the rest.

The hankering for the abstract is exemplified by the vogue attained by 'value' and 'values' in mining reports. In a stope or in a mill the use of 'value' in this way may cause no con-

fusion, even if it be an objectionable colloquialism, but in technical writing it should be taboo, as the very type of all that is non-descriptive and unscientific. "This mill is intended to extract the *values* in the ore" is a vague way of stating that the mill is designed to extract the gold or silver, the copper or the zinc—in short, the valuable metals in the ore. In one mill the zinc, for example, may be not only valueless but a deleterious impurity; in another the copper may be insufficient in quantity to be extracted profitably, but sufficient to interfere with the saving of the gold by cyanidation. 'Value' is the worth or desirability of a thing; it is an attribute, not a substance. A man who designs a mill "to catch the values" might as well build a railroad to pursue a quadratic equation.

(7) "In sinking, the *values* were lost." Meaning that the ore failed, or discontinued.

(8) "And then the gold *values* are precipitated on zinc shavings." No, it is the metallic gold that is precipitated; you can precipitate a panic by reckless banking, but you cannot precipitate anything so intangible as 'values' on something so tangible as 'zinc shaving'. As the farmer said, "It ain't in the nature of things".

(9) A mining engineer sent a cablegram from Nigeria stating: "There are many years' work ahead and from actual results the ground is good in *values*."

The ground might be rich in vulgar fractions!

(10) "All *values* can be freed from the gangue by better crushing." The gangue will be much relieved when these ghosts are exorcised.

(11) "It might be supposed that the beating of such particles of *metallic values* [metal] against the side of the tube-mill would anneal them and put *such values* [them] into leaf form."

(12) "The gold *values* are not chemically *united in* pyrite as a sulphide of iron and gold."

He means: "The gold is not chemically combined with the iron in the pyrite as a sulphide of iron and gold."

(13) "Better *values* are, however, obtained above the 1970-ft. level as the lode is *opened out*."

"Richer ore is being exposed in the course of stoping above the 1970-ft. level."

(14) "Rich sands in which the gold and platinum *values* are flaky and coated."

Here 'values' is interjected from force of habit. 'Value' cannot be "flaky or coated". Delete "values". The plural of 'sand' is not required.

(15) "Along the rivers the *values* are coarser than in the beaches."

He is referring to the particles of platinum; he should say so.

(16) "The *highest copper values* are concentrated along the post-dacite faults."

"The copper is concentrated along the post-dacite faults."

Sufficient examples have been quoted. The misuse of this word is among the most objectionable of technical solecisms. It connotes utter lack of precision. In every case it tends to befog the meaning, for even if the reader guesses that the writer is referring to a particular metal or mineral, the use of 'value' suggests such a proportion of the metal or mineral as will yield an economic—that is, a profitable—result. Only too frequently 'value' is used to designate mineral or rock containing too little of the valuable metal to be a source of profit—that is, to be 'ore'. In short, the woolly use of 'value' becomes a means of conveying an untruth. No word in the vocabulary of the mining engineer requires to be used with greater care than 'value'. It is a disgrace to the mining engineering profession that this term should be employed so loosely. Sir Clifford Allbutt has said truly: "It is strange that scientific men who habitually work in dimensions of a ten-thousandth of an inch are either blind to gross confusions of argument and to false refractions of meaning or regard them with indifference."

One of the greatest enemies to precision in technical writing is the use of the abstract instead of the concrete. An abstract noun denotes quality, state, or action, apart from anything

possessing the quality, state, or action. For instance, in preparing my first lecture, I wrote

(17) "Words are intended *for the conveyance of ideas.*"

But I corrected myself:

"Words are intended to convey ideas."

(18) Again, I wrote: "If you do so, you will *succeed in avoiding* most of the grosser errors."

This I changed to:

"If you do so, you will avoid most of the grosser errors."

Prefer the concrete to the abstract. The use of the abstract tends to circumlocution; it produces obscurities that are fatal to precision.

(19) "Repair work was greatly facilitated *by the presence* of chutes every 25 ft. along the drifts."

How can "the presence" of a chute facilitate repairs? It is the use of it that helps. He meant:

"The work of repair was facilitated by using the chutes, which had been placed at intervals of 25 ft. along the drifts."

(20) "Such deposits of quartz are not valuable unless they are close to *cheap transportation.*"

The abstraction 'cheap transportation' is a mere indirection in place of the concrete idea expressed by 'railway' or 'steamer'; he does not say which.

(21) "When tungsten ore occurs in disseminated grains, it is more difficult *of detection* [to detect] than when it is found in masses of considerable size."

(22) "It is this accumulation of ore *which* [that] is *at the same time the cause of present conditions* and a preventative of an early release of the embargo."

This statement is burdened with many useless words. "Preventative", of course, is a sophomoric blunder. Even 'a preventative' is a roundabout way of stating what he means. I suggest a change to:

"This accumulation of ore threatens the market and prevents an early release of the embargo." The embargo refers to the refusal of the local smelters to treat more ore.

(23) "When the oxygen in air is gradually reduced very little effect may be noticed before *the occurrence of impairment* of the senses and loss of power over the limbs."

A loss of power in the writer's pen may be noticed likewise. His two abstract nouns, 'occurrence' and 'impairment', becloud his meaning almost to the vanishing point. He means:

"When the oxygen in air is reduced gradually, the effect may not be noticed until the senses are weakened and the power to control the limbs is lost."

(24) "As pig-iron was used *for the precipitation of* [to precipitate] the copper."

(25) "Fine grinding was introduced, and with it the *more or less complete elimination of* amalgamation as one of the means of extracting the precious metal from the ore."

To introduce "the elimination of amalgamation" is not good form in literary society.

"Fine grinding was adopted, and amalgamation became no longer necessary to extract the gold from the ore."

(26) "In order that the subsequent *sinking* through the rock to the coal-bearing veins could be *proceeded with*."

The statement is improved by substituting the direct phrase for the circumlocution, thus:

"In order to sink through the rock to the coal-seams without further delay."

(27) "He continued the drift so long as *the richness* of the ore lasted and then he ceased *his exploration*."

"He continued to drift only as long as the rich ore lasted."

(28) "The mill-superintendent found that he improved *the extraction of the gold by a previous precipitation of* the copper in the ore."

"The mill-superintendent found that he could extract more gold if he first precipitated the copper in the ore."

(29) "If the feast-days were not *of such frequent occurrence* [so frequent]."

(30) "Much has been done *in the investigation and study of* [to investigate] the local geology." Investigation involves study.

(31) "The glass model of the mine is most instructive and illuminating in setting forth *the nature of* the development, exploitation and geological features of the property."

"The glass model shows admirably the development, exploitation, and geology of the mine."

(32) "Anything that tends *toward atrophying* [to atrophy] the power of the individual."

Nothing tends so much to atrophy the function of writing as the frequent use of the abstract instead of the concrete. As Spencer said: "Exactness is not only unappreciated by, but even repugnant to, minds in low stages."

(33) "It seems rather a waste of opportunity to fall back on 'basic salts' when there are so many other scintillating resources open to our pencil-and-paper speculative *chemistry*."

He spent too much effort in scintillating and not enough on correct expression; he uses 'chemistry' for 'chemists', the abstract for the concrete, and thereby spoils his rhetorical outburst.

In nouns, prefer the concrete to the abstract; in verbs, choose the active voice rather than the passive, and the positive rather than the negative.

(34) "An outline of the process may *be of help to* those not familiar with cyanidation."

Delete the three words indicated.

(35) "These alloyed metals are the most difficult of *solution* [to dissolve]."

(36) "By *a refusal* to recognize the union he secured *an assurance* of freedom in his operations."

"By refusing to recognize the union, he assured himself freedom in his operations."

(37) "These demands for supplies must be anticipated, often as much as six months, *to allow the certainty of the goods being on hand when needed*."

The last clause should read, "so as to have the goods on hand when needed".

(38) "This makes it necessary to determine the value of

all sorts of property, a task *which* [that] will be *productive of* [create] endless disputes."

The direct statement is more explicit.

(39) "This *makes* the use of coal for generating power prohibitive."

"This prohibits the use of coal for generating power."

(40) "This *will be dependent* upon other conditions."

"This will depend upon other conditions."

"A remarkably cheap machine" is better than "A machine of remarkable cheapness."

"He increased the speed of the machine" is better than "The machine was given an increase of speed."

As Quiller-Couch says: "The first virtue, the touchstone of a masculine style, is its use of the active verb and the concrete noun. When you write in the active voice, 'They gave him a silver teapot', you write as a man. When you write 'He was made the recipient of a silver teapot', you write jargon."

Those who hanker for the abstract also use the plural unnecessarily.

(41) "An effort *to obtain further reduction* in working costs."

Here we have an abstract noun and the plural used to make a vague statement, instead of saying:

"An effort to reduce the working cost still further."

(42) "The extra *costs to be met* with as depth is obtained."

Why the plural of cost? Note also the childish "to be met with". He means:

"The increased cost ~~to be incurred~~ as depth is attained."

(43) "The ores occur in limestone and are thoroughly oxidized, so that the occurrence of galena is rather uncommon."

He was writing about the ore of a particular mine remarkable for containing a peculiar kind of galena used in the apparatus of wireless telegraphy.

"The ore is found in limestone and is thoroughly oxidized, so that galena is rare."

(44) "Resulting in less losses of gold and lower costs, 56 to 35 cents per cubic yard."

Why the plural? He means:

"The result being a smaller loss of gold and the reduction of the cost from 56 cents per cubic yard to 35 cents."

(45) "The discoverers were guided to the outcrop by *the occurrence of the gold in the gravels of the neighborhood.*"

The 'occurrence' did not guide them, but the gold they found.

"The discoverers were guided to the outcrop by the gold they found in the gravel near-by."

Why gravels? Because it sounds more comprehensive, more inclusive, more magnificent. The squandering of that valuable inflection, the plural, is all part of the love for the abstract, the dislike of the concrete. In the above example the writer referred to a deposit of gravel, possibly to more than one deposit of gravel, but not to several kinds of gravel. One might suppose that each bit of stone in such an alluvial deposit was a 'gravel' and that the accumulation of them made 'gravels'. Illiterate men undoubtedly retain this idea. As used in geology, 'gravel' is a term covering a particular kind of deposit and the collective form of such a deposit. In the same way careless writers talk about "a vein in the slates", recalling the individual slates on which they did sums when small boys, or thinking of the 'slates' used for roofing. In geology, 'slate' is a rock characterized by a cleavage independent of the planes of sedimentation. 'Slates' should refer to several series of such rocks. The man who uses 'gravels' and 'slates' when he means to refer to a deposit of the one kind or to a rock of the other kind has squandered a useful inflection; and when he really needs the plural to indicate several kinds or deposits of either 'gravel' or 'slate' he is unable to do so.

Until a few years ago it was the invariable custom when referring to various mill-products to speak and write of 'slimes', 'sands', 'tailings', 'middlings', and 'concentrates'. The singular had dropped out of use. Indeed, habitual carelessness of speech had developed such an absurdity as the use of 'tailings' to indicate the pyritic concentrate collected in the stamp-mills of

Colorado, and the employment of 'rock' to designate the copper ore of Michigan. Engineers write of the 'ores' of a mine that produces only one kind of ore and talk of the 'rocks' that a vein traverses when it is wholly encased in one kind of rock.

This is a mormonism of style; it leans toward the vague and poetic, as we speak of "the sands of Time". It bespeaks that inveterate love of the abstract against which I have been warning you. In technology, the unnecessary plural (I had written "these unnecessary plurals", but corrected myself) is an obstacle to precision. For instance, a 'concentrate' is the product of a concentrating process; if several such products are obtained, as happens frequently, they are called correctly 'concentrates'. Thus:

(46) "At Broken Hill the mills produce lead and zinc concentrates, the lead concentrate being more easy to sell than the zinc."

Does not the discriminating use of the plural inflection help to make the meaning clear? Here is another good example:

(47) "An intimate mixture of the pyritic and the lead concentrates is made, resulting in a product assaying 15 oz. alike in gold and silver, and about 25% lead."

These two products of concentration, characterized by pyrite and galena, respectively, are mixed to form one product before shipment to the smelter.

(48) "Seven different slimes were tested, the results being given herewith. These slimes are derived from as many ores, from different parts of the mine or from several dumps."

Note the value of the plural in 'slimes', 'results', 'ores', 'parts', and 'dumps'.

The pulp in a mill, when classified, is separated into a coarse product, 'sand', and a fine product, 'slime'. More than one kind of these products is made.

(49) "An experiment was made on two sands having the following analyses. Which *sands* is the *finest*?"

He meant "Which sand is the finer?" A more intelligent writer says:

(50) "Here, as at El Oro, one can calculate exactly the extraction from a sand when the sizing-test has been made."

The discard from a mill or machine is the 'tailing'. Suppose, as often happens, that the discards from several similar machines are mingled while on their way to be re-treated by another kind of machine, how are you to express the idea if you have beggared yourself of your distinction between singular and plural?

(51) "This idea of not returning the middling to the machine that has separated it, has been adopted as a vital principle of the mill. The middlings of the classifying jigs (products No. 8 and 9) and the hutch-product (No. 13) are crushed separately through fine rolls. The crushed product has the characteristic that practically all the galena freed by crushing is found in the fine sand and slime, and that the oversize of a 22-mesh screen (0.6 mm. aperture) does not contain sufficient free galena to make it worth while to concentrate the oversize before re-grinding."

Note the intelligent use of the singular of 'middling' in the opening sentence and the effective use of the plural immediately afterward. If the plural of 'sand', 'slime', 'oversize', and 'product' had been employed in the fashion of the ordinary careless writer, the meaning of the statement would have been fogged. It is not easy to write clearly on such highly technical operations, and it is impossible to do so unless we use every device for making fine distinctions. One of the elementary distinctions is furnished by the plural; why throw it away?

On this detail in technical writing I have insisted for many years, and not without effect. When the leaders in technical science in South Africa decided to prepare a comprehensive treatise on the mining and metallurgy of the great goldfield of the Witwatersrand they issued a style-sheet requesting contributors to use 'slime', 'concentrate', 'tailing', and so forth, unless the reference was to several of these products. Many American technical writers and practising engineers have adopted my suggestion. Other mormonisms persist. Writers

speak of 'fines' but they do not say 'coarses'; why not use 'fine' in contrast to 'coarse'? Writers on the geology of mining districts often speak of 'schists', 'limestones', and 'sandstones', when the reference is to one, and only one, terrain or formation of schist, limestone, or sandstone. Here again the idea lurks in the background that a layer of limestone is a limestone, a bed of sandstone is a sandstone, and a lamina of schist is a schist. It is impossible to tell from the statements of such writers whether they are speaking of several formations or of several kinds of limestone or schist.

(52) "The vein crossed the bedded sandstones."

He means "the beds of sandstone".

(53) "The banded ironstones have been much disturbed and shattered."

This refers to a single formation of banded ironstone; he has his eye on the multiple bands of the ironstone.

(54) "The slates being highly silicified cause the main lode shear-lines to split."

He means that

"The slate, being highly silicified, causes a splitting of the shear-zone that constitutes the main lode."

Coal for domestic use in England was formerly called 'sea-coals', because it came by sea and because each piece was supposed to be a 'coal', and Englishmen still speak of 'coals', meaning 'coal' in the sense in which the word is used in America, where the plural may be used to signify different kinds of coal.

Note the fondness for the plural in references to depth:

(55) "In this mine the ore has been followed to great *depths*."

He means "to a great depth".

(56) "Rich ore has been found to considerable *depths*."

In such phrases the plural causes vagueness, and, presumably, to ignorant persons it seems more impressive for that reason. As a technical statement it loses in precision and in effect. Substitute the singular and see for yourself.

Better, however, than either the singular or the plural of 'depth' would be the actual measurement in feet, for the term 'depth' is relative and means little apart from some standard by which it may be measured.

Here are some more examples of the unnecessary plural:

(57) "The labor situation *on these fields* is critical."

This is a common British vulgarism. The reference is to a particular goldfield, that of the Rand. 'Fields' is bucolic.

(58) "In January we treated 3186 tons of *concentrates* and produced 2711 tons of *calcines*."

One kind of concentrate was treated, yielding a uniform calcine.

(59) "Our *costs* for roasting are of little value on account of the shortness of the period."

Why the plural? He refers to one item of expense, not several.

(60) "Extensive *tracts of alluvials*."

He meant "an extensive tract of alluvial ground", but thought it grander to use two plurals.

(61) "These *estates* contain important deposits of iron ores as well as gold and copper *ores*."

Only one kind of iron ore—hematite—was known to exist, therefore the plural is misleading. The property consisted of one consolidated group of mining claims, therefore 'estates' is only a sample of careless magniloquence.

A professor writes concerning the treatment of quicksilver "ores" by flotation. He had in mind the one important ore of quicksilver, cinnabar, and was not referring to native mercury, electrum, or meta-cinnabarite. Moreover, in discussing a metallurgical process, he would have been more precise if he had referred to the mineral itself (cinnabar) rather than to 'ore', much less "ores", and added a note concerning the nature of the gangue.

(62) "His present whereabouts *are* unknown. The editors of the 'Atlantic Monthly'".

This appears in a foot-note. The use of the plural verb

suggests that he might be in several places at the same moment. The editors do not know the particular place where he happens to be, and the use of the singular verb would convey the correct idea without puzzling the reader further. 'Whereabouts' is not a true plural, but merely a variant of 'whereabout'.

The choice between singular and plural is a matter of haphazard to many writers. For instance, United States, Government, Cabinet, committee, company, management are given a plural verb more often than the singular. Sometimes both are used in the same context. The American Ambassador to the Court of St. James, in transmitting a diplomatic note from Washington to the British Government under date of December 28, 1914, used the plural and the singular impartially after 'Government', thus:

(63) "The Government of the United States *have* viewed."

"The Government *has* so often exhibited."

"The British Government *were* satisfied."

"This Government *is* forced."

"The Government of the United States *do* not intend."

"This Government *is* informed."

"The Government of the United States *are* informed."

"The Government *believes*."

"The Government of the United States *expresses*."

It is correct to say: "The United States is a great country"; also "These United States have increased in number since the Civil War." The United States is a political entity.

The Government is a unit. The members of it *are* united for purposes of national administration. The Cabinet *is* a select committee of the party in political control; the politicians in the Cabinet *are* men of various aptitudes. We say "The company *is* about to buy another mine", if this refers to the act of a corporation. So, likewise, "The management *was* highly respected", and "The *committee* consists of nine persons". In all these words the collective sense is implicit and the use of the singular makes it clear that the writer is speaking of collective

action or unified decision. If not, then the plural becomes necessary; thus "The members of the committee were unable to agree" is better than "the committee was not agreed".

The choice between the singular and the plural verb after a subject containing numerals is likely to perplex the technical writer. Thus, he will say either

- (64) "Fully 1000 tons of ore *was* crushed" or
 "Fully 1000 tons of ore *were* crushed."

The phrase '1000 tons of ore' signifies a quantity considered as a unit, not the separate tons, therefore the verb should be in the singular. While concord requires that a verb shall agree in number with its subject, yet when the meaning is in conflict with number, it is well to allow logical considerations to prevail over the grammatical, so that subject and verb are in different number, thus:

- (65) "5000 oz. of gold *was* produced."
 (66) "\$40 *was* collected."
 (67) "Three feet *was* then cut off the pipe."
 (68) "Twenty years *is* a long time."
 (69) "Forty yards *is* too far."
 (70) "Twice two *is* four."
 (71) "Two-thirds *has* been lost."

All the above are sanctioned by good usage. We say "1000 tons *was* crushed" because the idea of 'ore' is implicit and we are thinking of the tonnage in mass and not of a thousand separate tons. Such a locution refers to an amount in weight and not separate things. On the other hand, we might say: "Five tons *were* tested in one-ton lots"; but it is preferable to say: "Five one-ton lots *were* tested". Again, in "Forty barrels of oil *was* stored in the tank", the quantity measured in barrels is regarded as a unit; whereas in "Forty barrels of oil *were* stored in the warehouse" the verb may be plural if the oil is contained in 40 separate barrels meant to be considered individually.

- (72) "11 cc. of iodine solution *were* [was] used to titrate."

Here 'was' is inconsistent with the grammar, but con-

sistent with the idea, namely, that iodine to the amount of 11 cc. was used in the titration.

In such statements the idea of quantity is implicit, thus:

"An 11 cc. quantity (or volume) of iodine solution was used."

"A 1000-ton quantity (or weight) of ore was crushed."

The idea of quantity being implicit, the word for quantity is omitted, and we have the adjectival phrase alone remaining as the apparent subject.

Two nouns may indicate one subject: "A block and tackle is employed."

Collective nouns are sometimes joined to plural verbs when the statement is meant to apply to the individuals of a group, thus:

(73) "The people *are* one and they have one language."

(74) "The public *have* various opinions."

This view of the matter is stretched by some writers to sanction such phrases as:

(75) "The Smith & Jones Co. *have* built a new mill."

(76) "The management *have* refused to raise wages."

Such usage is not to be commended, because the building of a mill or the raising of wages is an act directed by the 'company' or the 'management' as a unit, not by the various members as individuals.

V. SUPERLATIVES AND OTHER DILUENTS.

The purposes of composition are various; one purpose, for instance, is to make a record for the writer's own use, as in a diary. That does not involve responsibility to others. There is also the writing meant to influence opinion, to be persuasive and pleasing. With such writing we need not concern ourselves at this stage of our study. The prime purpose of technical writing is to be informative—to convey information—therefore it must be clear beyond the chance of misunderstanding.

Such clearness is impossible if meaningless or wrong words are sprinkled through the text. Discard the trivial words that are constantly at your elbow. Brush aside a host of vapid superlatives. Metternich exclaimed: "The superlative is the mark of fools." It is a false emphasis, like the underlining in a school-girl's letter. For example, the little word 'very' can be deleted nine times out of ten; it is an impediment to terse and perspicuous writing, as the multitudinous hand-baggage of the British tourist is to his travel. 'Very' supposes comparison. A mine with a 1000-ft. shaft is *very* deep to the scribe who writes from the Joplin district, in Missouri, but it seems a shallow hole to a man living at Calumet, Michigan. A vein that is 10 feet across may be considered *very* wide at Cripple Creek, Colorado, but it is only a 'stringer' to the miner at the Homestake, in South Dakota. Ore assaying \$20 in gold is *very* rich at Treadwell, Alaska, where 5000 tons of \$2 ore is crushed daily, but it is relatively low-grade to the pocket-miner at Alleghany, in California. It is all a matter of comparison; unless your reader knows your standards of depth, width, or richness, your 'very' has no significance.

(1) "Where erosion was *very* rapid or oxidation *very* shallow" is a statement that immediately raises the question: What is the writer's scale of rapidity or shallowness?

(2) Sir Arthur Conan Doyle says: "It is *certain* that the Germans were *very* outclassed upon the three days of June which I allude to."

The 'certain' and the 'very' suggest exaggeration. An adverb, such as 'greatly' has been omitted before "outclassed". He misplaced 'to'; for he meant "the three days in June to which I allude."

The use of 'very' may defeat its purpose. Some words, like 'perfect' and 'unique', cannot be qualified. If a thing is 'perfect', no 'very' can make it more so. To say that a machine "makes a *very* perfect separation of the slime from the sand" is tantamount to saying that it makes an 'almost perfect', which is an 'imperfect', separation. A perfect separation is 100%, which is the limit of that kind of perfection.

'Unique' is a word that allows no qualification.

(3) "The manager of the Mount Boppy refers to *one* of the *most* unique sections of the mine."

Here the superlatives smother each other. If several such "sections" existed in the mine, none of them was unique. The one first disclosed may have been unique; the second killed the uniqueness of it.

(4) "A *rather* unique suggestion."

(5) "The process is *somewhat* unique."

If a thing be unique, that sufficeth. Similarly, such words as 'obvious', 'vertical', 'straight', 'moral', and 'honest' are not intensified by using an adverb; they are weakened. "A *very* vertical shaft" and "a *perfectly* straight adit" suggest the gilding of refined gold.

(6) "Constructing a tramway in a *perfectly* straight line."

A straight line is the perfection of straightness.

(7) "It is *very* obvious that the mine is worth the price asked."

It is obvious or it is not; it can neither be more obvious nor almost obvious. From the unnecessary emphasis we may suspect that it was *not* obvious that the mine was worth the price.

(8) "Guncotton is pressed into the requisite form in a wet

state, in which condition it is *very* safe to handle." The "very" weakens "safe", because the over-emphasis raises a doubt.

(9) "Lord Roberts is a *very* honest man" said the 'Westminster Gazette'. This suggests that perhaps politically his honesty was considered not above suspicion.

(10) "Charles E. Hughes is *exceedingly* honest, *extremely* moral, but not in the least progressive" said 'The Examiner'. Here the superlatives sap the strength of the sentence, and reduce it to mere verbiage.

(11) "The formation of the insoluble lime tungstate is *very* rare and has only been observed in one or two instances."

This statement is weakened by false emphasis. "The formation of the insoluble lime-tungstate is rare." That suffices.

These remarks do not refer to idiomatic phrases such as: "In *very* truth, he is a man." Idiomatic phrases are a law unto themselves. Here 'very' is an adjective; as also in "the *very* roots of human life". 'Very' makes a strong adjective, but a weak adverb. I will add this: if you employ 'very' infrequently, you will find it very useful, on occasion.

Even a word like 'great' has little meaning if worked to death. A newspaper reporter, describing the submarine 'Deutschland', said:

(12) "The *great* hull has been pressed out of one sheet of steel. The only break in the smooth contour is at the bow where her *great* anchors hang. But even here it is hardly a break, for the anchors fit snugly into *great* pockets that still maintain the roundness of the hull. The conning tower rises like the hump of a camel in the *great* boat's back."

'Most' is another word much over-worked and likely to hinder the flow of thought, as water is retarded by a riffle.

(13) "The ore deposit is *most* extraordinary."

(14) "This can be done *most* effectually in one way only."

'Doubtless', 'without doubt', and 'undoubtedly' are interjected in a careless way as an equivalent for 'perhaps' or 'probably', instead of being held to their true significance.

(15) "*Doubtless* the vein will persist in depth."

(16) "The men, *without doubt*, are honest in their intentions, but their methods are most objectionable."

'Certain' is a word of uncertain meaning.

(17) "A *certain* kind of oil is necessary in the flotation process."

Here 'certain' is used as a synonym for 'specific', but it would be better to specify what kind of oil is required. Delete 'certain' and state whether it be pine-oil, wood-creosote, or olive-oil, for example.

(18) "Tuberculosis occurs to a *certain* extent among the miners."

In this example 'certain' either means nothing or it implies uncertainty.

(19) "There is a tendency to limit the profit to a *certain* [fixed] percentage of the capital employed."

Avoid the habitual use of 'certain', so that when you do employ it there will be no uncertainty as to your meaning.

'Certainly', like its corresponding adjective, is another bluff word; more full of sound than significance. Here is a quotation from the New York 'Annalist':

(20) "*Certainly*, Dr. Jastrow's article is stimulating to thought and can be read with interest by British bankers, remarks this authority. But one finds few to accept his conclusions as a whole. *Certainly* American banking enterprise is finding an outlet in South America; *certainly, also*, America's new banking system should help New York to take an increasing share in international finance; *certainly, also*, British banks in South America will need all their skill and energy in the future."

These four 'certainlys', one of which might be emphatic while the four cancel one another, are like the coughs of a self-conscious speaker. The addition, twice, of 'also' increases the clumsiness of the performance.

'Considerable' is a woolly word, usually out of place in a technical statement.

(21) "*Considerable* [numerous] data of this kind are given by Lewis and Shorter "

(22) "*Considerable* [deep] oxidation explains the absence of sulphides."

(23) "A *considerable* amount of ore was sent to custom-mills before the company built its own mill."

Some, even approximate, figure should replace 'considerable', which depends for its value upon the writer's—not the reader's—*notion* of what is a large tonnage.

(24) "The plans for a plant of any *considerable* magnitude are not warranted."

Delete "considerable" and substitute a phrase that is more specific. Is it the cost that is the obstacle or the lack of sufficient ore? Then write either "The plans for an expensive plant are not warranted by the funds available" or "The plans for a plant of large capacity are not warranted by the tonnage of ore assured."

'Some', like 'considerable', is used in a loose, and usually meaningless, way.

(25) "Scotland produced *some* 3,500,000 tons of oil-shale."

(26) "This mine has yielded *some* 100,000 oz. of gold."

(27) "This process has met with *some considerable* success in the treatment of antimonial gold ores."

In each case 'some' is redundant; it means 'about' or 'approximately', and that is suggested sufficiently by the round figures. The last quotation is so woolly in texture as to be ludicrous.

'More or less' is another phrase it is well to discard in technical writing, which aims to be precise.

(28) "The ore has been subjected to *more or less* oxidation."

(29) "The workmen are *more or less* inclined to resent the order."

Delete 'more or less' in these examples.

(30) "The application of *more or less* complicated formulas is superfluous."

(31) "The impression that the bases of calculation are *more or less certainties* [certain]."

'More or less' is rarely needed, least of all in a discussion of accurate methods of appraisal.

(32) "Leaving no record other than scanty ruins, *more or less perfectly* [now] entombed in the drifting sand-dunes."

Do not imagine that the interlarding of qualifying phrases like 'more or less', 'to a greater or less extent', or even adverbs like 'about' and 'approximately', adds to the accuracy of your information or to the precision of your statement.

(33) "Crystals penetrated *to a greater or less extent* the substance of the rock fragments."

(34) "The spaces between have been *more or less completely* filled by cementing materials."

(35) "Ore-shoots are likely to be associated *to a greater or less degree* with fissures."

These three quotations come from the same technical article by a geologist who mistook the decoration for the substance of scientific truth.

'Probably', 'perhaps', 'about', and 'rather' are sprinkled in the sentences of engineers with the idea apparently of indicating carefulness of statement, but care is shown better by precision than by studied moderation of language.

(36) "A sampling plant was built *perhaps* five years ago."

Ascertain when it was built and give the date.

(37) "The lode is *probably about* ten feet wide."

Measure the lode and give its average width, as best you can. All such averages are subject to a reasonable discount; the insertion of 'probably' and 'about' will not avail if the average width of the lode prove to be six feet.

(38) "The quartz is *rather* hard and the walls are *very* straight." Delete the words italicized. Likewise in the two following quotations:

(39) "The movement of minerals shows a *rather* remarkable concentration."

(40) "This is *more* especially true of the smaller veins."

'Present' and 'presence' are often redundant; so are 'found to be' and 'known to be'.

(41) "The metallic minerals *present* in the ore."

(42) "*The presence* of other sulphides *was* [were] noted in this ore."

(43) "The sandstone is *known to be* jointed in places."

(44) "In this region the deposits are *found to be* low-grade."

In these four examples the words italicized are superfluous. 'Et cetera' or 'etc.' is improper after 'for example', or 'such as'.

(45) "The ore contains various sulphides, such as galena, blende, pyrrhotite, *etc.*"

Delete "etc." and insert 'and' after "blende".

(46) "After the copper sulphides, such as chalcocite and chalcopyrite, *etc.*, are reduced to a fine state of comminution."

The "etc." is not wanted. He had in mind these two sulphides, and no others. The "etc." suggests that he had something up his sleeve.

This silly little abbreviation is also used to round a statement or to make it seem more inclusive, thus:

(47) "Natives are employed in stoping, tramming, timbering, *etc.*"

(48) "Telluride ore is found in the Contention, Old Judge, Telegraph, Sarah Jane, *etc.*"

He had mentioned all the mines in which, so far as he knew, telluride ore had been found. The "etc." was a mere flourish. It reminds one of items in the social column of a local newspaper, such as:

(49) "Mrs. Ebenezer J. Judkins gave an elegant dinner party, her guests being Mr. and Mrs. Algernon H. Smith, Mr. and Mrs. Adams Wheelock Brown, *and others.*" No one else was present, but it sounded fine and large to add "and others".

'However', 'therefore', 'nevertheless', 'moreover', and similar adverbial connectives should be used sparingly. They are better placed parenthetically within the sentence than at the beginning.

The British have a way of disarming criticism by using qualifying words and phrases like 'somewhat', 'on the whole', 'be this as it may', 'we venture to conclude'. Gracious as these may be in some forms of expression they should be excluded from technical writing, which is best when most explicit and least upholstered.

(50) "The working costs have not been abnormally high, running, *as they have done*, only a trifle in excess of the average of the whole of the Witwatersrand."

The statement is meant to disarm criticism by its gentle verbiage.

(51) "A sampling plant was built *perhaps* five years ago."

(52) "A *somewhat* important development is announced from El Oro."

(53) "It is *rather* rare to see such a rich vein."

This "orgy of moderation", as it has been called, is almost a disease among our British friends; it has grown from their love for "the emphasis of under-statement", as Thomas Hardy calls it. British technical writers appear to shy at plain statements of facts as if it were bad form to be explicit. This fault, however, is not unknown in America. The editor of the 'Saturday Evening Post' says:

(54) "That war, *on the whole*, lowers the morale of the personnel is possible." He tries to give dignity to a bit of piffle by inserting a qualifying phrase.

(55) "The average run of ore contained *about* 30% silica, *more or less*."

He must have been decidedly uncertain about it, for he protects his 30% both fore and aft.

The secret of a vigorous style is the rejection of the superfluous word.

Permit me to quote Henry James again; he was addressing students—young women of the highest type—when he said: "I am asking you to take it from me, as the very moral of these remarks, that the way we say a thing, or fail to say it—fail to learn to say it—has an importance in life that it is impossible

to overstate—a far-reaching importance, as the very hinge of the relation of man to man.”

Henry James spoke thus “in those days when his sentence was a straight young thing that could run where it liked, instead of a delicate creature swathed in relative clauses as an invalid in shawls.”*

*Rebecca West.

VI. IT, ONE, WITH, WHILE.

Freeman, the English historian, said that he had learned from Macaulay "never to be afraid of using the same word or name over and over again if by that means anything could be added to clearness or force. Macaulay never goes on, like some writers, talking about 'the former' and 'the latter', 'he', 'she', 'it', and 'they', through clause after clause, while his reader has to look back to see which of several persons it is that is so darkly referred to." He might have learned also from Macaulay that a preposition makes a feeble ending for a serious statement.

How often do you hear 'the former' and 'the latter' in conversation? Good conversation is a guide not to be disdained. When you must use 'the latter', do not confuse it with 'the last'.

(1) "Cheap labor, cheap fuel, and cheap transport are essential, the *latter* [last] being particularly important in base-metal mining."

(2) "The apparatus may be used to determine such gases as hydrogen sulphide, chlorine, oxides of nitrogen and some others, as well as sulphur di-oxide. In the case of the *latter* [last] two, etc."

The last two mentioned are "sulphur di-oxide" and "some others". He should have stated which two and he should have avoided that jargonese phrase "in the case of".

Sir Clifford Allbutt ridicules the false sense of tautology. As an example, he quotes:

(3) "In the first series the reaction was present on 37 occasions, in the second series it occurred 32 times, while in the third it was observed in 27 instances."

This should be: "In the first series the reaction was observed 37 times; in the second, 32 times; and in the third, 27 times."

It might even be better to delete "times" in the second and third clauses.

Cobbett says: "The word 'it' is the greatest troubler that I know of in language. It is so small and so convenient that few are careful enough in using it. Writers seldom spare the word. Whenever they are at a loss for either a nominative or an objective to their sentence, they clap in an *it*."

(4) "The cartridge has fuse attached to *it* and *it* is split before *it* is shoved up."

The first 'it' refers to the cartridge, the second to the fuse, and the third again to the cartridge.

(5) "About two years ago, when *it* was found necessary to erect a new school-building, *it* was thought by many that some attempt should be made to give instruction to those engaged in mining. *It* was decided, therefore, to establish a mining-school in connection with the high-school and *it* proved a success."

A medley of different 'its' in a single sentence, like the above, is undesirable; the mixture of the indefinite or impersonal 'it' (the first three in the example) with the concrete 'it' (the fourth, which appears to refer to the "mining-school") is confusing. The sentence is bad, not only because of this mixture, but because of the repetition of 'it'; the phrasing can be accepted as far as the word 'school-building', which might be followed by "many thought that some attempt should be made to give instruction to those engaged in mining. A mining-school therefore was established in connection with the high-school and proved successful." Such phrases as "it was found necessary" and "it was decided" are not objectionable, as expressing public necessity or public decision, but they should be used sparingly.

(6) "The ore is scattered through the formation, and *it* is difficult to follow."

Which was difficult to follow, the ore? the formation? If the ore, "it" is unnecessary; if the formation, "and it" should be replaced by 'which'.

(7) "The air-compressor also operates the sinking-pump, so that *it* is an economical machine."

Was it the pump or the compressor that proved economical?

(8) "The fire at the Champion mine made *it* necessary for the company to shut-down *its* mill, and *it* is probable that *it* will remain idle for several months, until *it* is in a position to produce the usual supply of ore."

Here are five 'its', three of which appear to represent concrete things. Does the fourth refer to the company, the mill, or the mine? The fifth 'it' may refer either to the mine or to the company. As an alternative I suggest:

"The fire at the Champion mine compelled the company to shut-down the mill, which will remain idle for several months or until sufficient ore can be supplied."

(9) "The thickness of the strata described as chalk by the driller is much greater in the southern field and *it* rests, in four cases out of five, directly on sand."

What rests? "The southern field"? No, the chalk. The 'and' can be replaced by 'where'; and 'chalk' had better be repeated instead of using the confusing 'it'.

Do not hesitate to repeat a word in order to make yourself clear. Perspicuity is the better part of elegance.

(10) "For reasons that need not be discussed, a solute that lowers the *surface*-tension of a liquid concentrates at the *surface* of the solution, but this process of concentration, called 'adsorption', takes a certain definite time to reach its full value. Now, if a film of the solution is stretched, a new *surface* is produced and this new *surface* at the moment of production possesses greater *surface*-tension than the rest of the *surface*, because the *surface*-adsorption has not had time to reach its full value."

In this paragraph the writer has used the word 'surface' repeatedly in order to make himself clear. He is discussing a particular force, surface-tension, and avoids the risk of misunderstanding by giving it in full again and again. He might have used 'tension' without the adjectival 'surface' after

“possesses greater”, and he might have omitted ‘surface’ before ‘adsorption’ near the close of the paragraph; but if he erred, he erred on the right side. He is dealing throughout with essentially surficial phenomena and he emphasizes the fact. For that reason the repetition is to be commended.

Please do not weigh the value of my admonitions entirely by the manner in which they are conveyed to you. I have read a sufficient number of books on grammar, composition, and writing to know that the exponents of these subjects—some of them far better equipped than I—commit many of the errors against which they warn their readers. My position is much like that of the honest, but bibulous, clergyman who told his congregation: “Do as I say, not as I do.”

> An ungainly use of ‘with’ is noteworthy in technical writings.

(11) In preparing the second lecture I had written: “‘Certain’ is a word *with an* uncertain meaning”, but I changed “with an” to ‘of’.

(12) “The vein has a north-east strike *with* [and] an easterly dip.”

(13) “The vein becomes richer *with* [in] depth.”

(14) “The Bolivians produce good ore and concentrates *with* [at] a small *outlay of* expense.”

Here ‘with’ is more objectionable. The ore and concentrate are produced *at* a small cost. Delete “outlay of”.

(15) “*With* the value of the boliviano as fixed by law, the difference of exchange becomes burdensome.”

This is worse. He should have said: “Since the value of the boliviano is fixed by law, the difference, etc.”

(16) “*With* the high smelting rate *existing* in England and the *practical* impossibility of getting ore into Germany for reduction, it seems that *with* fair offers in price the American smelters will be able to command a supply of tin ore from Bolivia.”

This is still worse. He means: “In consequence of the high smelting-rate etc.”, and when he uses ‘with’ a second time he

means that "if fair prices are offered, the American smelters should be able etc." 'Existing' and 'practical' are redundant.

(17) "Why are the ore-shoots limited to the middle andesite *with* [whereas] the *earlier* [lower] and upper flows [are] barren?"

Here 'with' is used in place of 'whereas'. He might have said: "The lower and upper flows of andesite being barren, why are the ore-shoots limited to the middle flow?"

(18) "The world's production of each of the three base metals was 1,000,000 tons *with* [but] lead slightly *exceeding* [exceeded] copper and zinc."

The sense of equal production is better expressed by putting the "each" after "tons". He might have phrased the last clause thus:

".....but the production of lead slightly exceeded that of copper or zinc."

(19) "Even *with* slimes that settle well *with* lime, this method is undesirable."

He means "This method cannot be recommended even when applied to slimes that are made to settle by aid of lime."

(20) "*With* a crushing device *which* utilizes the principle of abrasion peculiar phenomena are sometimes presented."

This is jargon. He means: "Crushing devices that utilize the principle of abrasion sometimes produce peculiar phenomena."

(21) "*With* the new furnaces in operation, smelting *with* the cheapest fuel available at present, *with* cheap power from waste gases, and *with* the Pierce-Smith convertor operating, the plant will be completely up to date."

This is a sample of journalese. 'With' stands for 'when'.

"When the new furnaces are in blast, when the Pierce-Smith convertors are in operation, when cheap fuel is used and when the waste-gases are utilized to generate power, this plant may be considered thoroughly up-to-date."

(22) "*With the exception of* [except for] the altitude, the conditions are favorable to mining."

(23) "*With* [in consequence of] the rising cost of machinery,

foodstuffs, and labor, *and with* [as against] a fixed value for their output, the gold mines are facing unprecedented conditions."

In the 13th book of the 'Say of Confucius' it is recorded: "On matters beyond his ken a gentleman speaks with caution. If names are not right, words are misused. When words are misused, affairs go wrong. When affairs go wrong, courtesy and music droop, law and justice fail. And when law and justice fail them, a people can move neither hand nor foot. So a gentleman must be ready to put names into speech, to put words into deeds. A gentleman is nowise careless of words."

'While' means 'during the time that' or 'for as long as'. It is a mistake to use it for other purposes.

(24) "The orebearing sandstones, which dip eastward, are locally termed 'vetas', *while* [whereas] those dipping eastward are known as 'ramos'."

The reference is not to time but to the direction of dip. It is well when using foreign terms, such as the Spanish words in the above quotation, to insert the English equivalent in parentheses, thus 'vetas' (veins) and 'ramos' (branches).

The same writer mixed his prepositions:

(25) "These beds of sandstone have been found to contain ore *at* [to] a depth of over 1600 ft."

He did not mean that they were ore-bearing only at 1600 ft., but that they continued to be ore-bearing down to 1600 feet.

(26) "Enormous quantities of agricultural waste from the farms are disregarded, *while* [although] they contain elements from which valuable substances can be derived."

(27) "This refers to experiments *where* [in which] roasting was tried."

Another objectionable mannerism is the use of the indefinite pronoun 'one'. This is distinctly a British habit, but many Americans affect it, and, being common among well-bred people, it has a vogue against which a careful writer should be on his guard. In technical writing it is a plain nuisance.

(28) "*One* dined late, therefore *one* did not walk to the club until ten o'clock", instead of

"I dined late, therefore I did not walk to the club until ten."

(29) "I am engaged in reciting the incidents in *one's* [my] life." This is a panicky attempt to escape egotism in an autobiography.

The 'Westminster Gazette' says:

(30) "Then cricket will become a sport without nerves, and *one* of which *one* will willingly become a spectator."

Lord Rosebery remarks:

(31) "The less *one* says about a toast *one* knows nothing about the better for *one's* self and the audience."

Note the preposition-verb and the misplaced preposition.

J. L. Garvin wrote recently in 'The Journal' of the Institute of Journalists as follows:

(32) "This you say is a talk by a journalist to journalists! So *one* had often declined. At last, in answer to the latest and most urgent invitation from French friends, *one* determined to go, and now the wonder seems that *one* did not go before."

He means that *he* had often declined to visit the front in France, until at last *he* determined to go and then wondered why *he* had not gone before. Substitute 'I' for 'one' throughout. The statement is only interesting as referring to the ideas and movements of the speaker, the versatile editor of the 'Observer'.

(33) "*One* had noticed that in Cornwall the miners had never been able to *get rid of* the influence of the smelters in selling their ore."

Again the mock-modest 'one' is associated with a preposition-verb. The observation is uninteresting unless backed by the personality of the observer. He might have said:

"I had noticed that the miners in Cornwall had been unable to escape the dominance of the smelters."

(34) "*One* used generally to prospect with a cocoa-nut shell, and when *one* wanted to try a piece of ground on a bigger scale the thing would be to take down a tree, beat the bark off, spread it out, and use that as a launder. *One* would follow this

by doing something else. *One* also came across very curious furnaces," and so forth.

This is quoted from the Transactions of the Institution of Mining and Metallurgy. It is the rambling description of a modest man, shrinking from being too downright and avoiding even the semblance of pedantic accuracy; hence the woolly texture of his verbiage. He was writing about prospecting in the Malay peninsula. His description has no scientific value unless it be the testimony of an eye-witness; being such, he ought to accept the responsibility and use the definitive 'I'.

(35) "In *one* instance *one* had anything but a positive discharge and a positive feed, whilst in the other, *one* had both of these points absolutely defined."

Note again the clash between the numeral *one* and the pronoun *one*. This quotation, referring to heavy stamps, is also from the Transactions of the premier mining-engineering society of England. Part of the wearisome use of *one* is due to the custom of reporting in the third person—the *oratio obliqua*. This is objectionable in matters of scientific testimony. A record in the first person is safer and more intelligible.

The American uses 'they' as an indefinite pronoun, as if to compensate for abstaining from the use of 'one' *à l'Anglaise*.

(36) "It took thirty years to introduce oil flotation and *they* are now erecting a monument to the memory of the woman *who* [that] *first* discovered the process."

'They' stands for the public or those interested in mining. 'First' is redundant.

To return to our indefinite pronoun: a technical writer is a scientific witness; his testimony is valuable because he vouches for the accuracy of it; if he hide his identity under the mock-modesty of the indefinite pronoun he contravenes the purpose that is supposed to prompt his utterance. To begin a statement in the first person may seem assertive, but it simply asserts the responsibility of the writer, identifies the witness, and places him on record as testifying to the fact. To begin with 'one' is to start under a cloud of impersonality, to evade respon-

sibility, and to pose as a nebulous nonentity. In technology it is necessary to sacrifice elegance to precision; the writer on technical subjects is expected, not to pose, but to speak to the point without wasteful circumlocution or mincing affectation.

Some people seem to consider the first person positively indecent—they shun it. Of course, unnecessary egotism is objectionable, and the needless repetition of 'I' is a fault, but the intrusion of self into a matter that is personal, as testimony must be, does not come under the ban of good taste. On the other hand, the indefinite pronoun has its use, of course, when one desires to be impersonal. Thus "One may well be afraid when the lions roar" is a pleasant way of expressing the idea of fear without attributing timidity to any person in particular. "One is loath to impugn the President's motives" is a proper way of suggesting more than an individual questioning of his motives. Likewise when one is generalizing, the introduction of the ego may be unnecessary or even annoying; thus: "The training of mining men has usually been so broad that *I find* [one finds] them at home in almost any branch of military engineering." However, in technology the need of 'one' in such contexts does not arise often.

I have criticized two Britishisms, not out of ill-will, but for a definite purpose, and I have referred to one or two Americanisms in exactly the same spirit. To my mind Britishisms and Americanisms are equally objectionable; they are provincialisms detrimental to the currency of the English language, which is the common heritage of both peoples. The official language of the United States, a language that originated in Great Britain, is spoken in the same way by those who speak it well on both sides of the Atlantic. I can assure you that Mr. Eliot and Mr. Choate, for example, speak exactly the same language as Mr. Asquith and Mr. Balfour; and if any of us speak or write differently from them, we may be using British or we may be using American, but we are not using English.

VII. THE RELATIVE PRONOUNS.

An educated man is distinguished from others neither by his clothes nor by his knowledge; he is remarkable not for the things he says, but for the way he says them. You cannot even stand with him under an archway in the rain without finding him out. He may talk only of the weather. His words and his phrases alike may be simple. What distinguishes him is the arrangement of his words; however desultory his talk, it will be methodical; he has habituated himself to foreseeing the part to be played by each word he uses, and the place to be taken by each sentence he utters. On the other hand, the uneducated man, though shrewd and well-informed, will relate facts and events as they recur to him, generally in disorder; in his effort to recollect and in his attempt to rectify forgetfulness, he will pause irregularly, filling the intervals with meaningless phrases, such as "and then", "and so", or "said he to me", "said I to him", and even the continuous parts of his story will be told confusedly, because he has not learned the proper use of words.*

My own experience as an editor of technical manuscript has taught me that ignorance of the proper uses of 'that' and 'which' is a fruitful cause of obscurity and confusion. The relative pronouns have distinct functions, and no writer can express himself clearly until he has learned to discriminate between these functions.

(1) "The company is about to erect a leaching-plant for the silver-tin concentrate *which* did not find a remunerative market either in England or Germany."

'Concentrate *that*' would mean only the particular portion for which a remunerative market was not found.

* Borrowed, and changed, from Coleridge.

'Concentrate, which' would mean all the silver-tin concentrate.

'Concentrate which' could have either meaning.

(2) (a) "The engineers *that* refused to submit were discharged."

(b) "The engineers, *who* refused to submit, were discharged."

The first means that only a few recalcitrant engineers were dismissed, whereas the second means that all the engineers were recalcitrant and all of them were dismissed.

(3) "The Trail smelter is treating ore from the Sunshine mine at a profit *which* runs only \$6.10 per ton."

Is the profit \$6.10? No; for that would be ample, and would render 'only' superfluous. It is the ore that assays only \$6.10 per ton. Substitute 'that' for 'which' and the meaning becomes clear. At the same time re-arrange the sentence thus:

"The Trail smelter is treating, at a profit, ore from the Sunshine mine that assays only \$6.10 per ton."

The clause "at a profit" may seem to be interjected awkwardly, but it is placed where it will be emphatic, as it should be. 'Profitably' might be substituted.

(4) "All the ore from the lower level *that* is not now under water is being sent to the mill."

What is under water? The lower level? or only a part of the ore on the lower level? If the lower level is meant, 'which' should replace 'that' and two commas are needed to complete the relative clause, thus:

"All the ore from the lower level, which is not now under water, is being sent to the mill."

The dangers of punctuation can be lessened by writing: "Since the lower level is not now under water, all the ore from it is being sent to the mill."

If a part of the lower level is under water the sentence should read:

"All the ore from the part of the lower level that is not under water is being sent to the mill."

(5) "I recommend the flotation process *that* has been developed so successfully in Australia for the treatment of the ore at Miami."

He does not say what he means. He recommends the flotation process in general and intends to remark incidentally that it has been developed successfully elsewhere; he is not recommending a particular flotation process noteworthy as having been developed in Australia. He can express his meaning clearly by changing 'that' into 'which' and by placing a comma before 'which' and after 'Australia'. It will be better to re-arrange the sentence thus:

"For the treatment of the ore at Miami, I recommend the flotation process, which has been developed so successfully in Australia."

The relative pronouns serve for reference and connection. 'Who', its possessive 'whose', and its objective 'whom' should properly refer to living things, usually persons, sometimes animals. By poetic license we may speak of "the city whose future is assured". But it is inadvisable to say: "The smelter whose operations are profitable". Poetic license is not permissible in technology. So we may say: "The smelter, which is operating at a profit, continues to produce the usual quantity of bullion."

Historically 'whose' is the possessive of 'what' as well as of 'who', and it is still used as equivalent to 'of which', particularly when the latter produces an awkward construction. Hill states the rule* thus:

"'Whose' is used of anything with animal life or of anything personified; 'of which' is used of anything without animal life, unless euphony requires 'whose'." He suggests that it sounds better to say:

(6) "The Lilliputians ask Gulliver to destroy the nation whose ships he had already taken" than

"The Lilliputians ask Gulliver to destroy the nation of *which* he had already taken the ships."

* 'Beginnings of Rhetoric and Composition', by A. S. Hill, p. 729.

Yet Professor Hill approves

(7) "A lady inquired if a monthly magazine, the name of which was unknown to me, had yet arrived."

Preferring this to

"A lady inquired if a monthly magazine, whose name was unknown to me, had yet arrived."

Shakespeare says in familiar lines:

(8) "The undiscovered country from whose bourn
No traveler returns"

But, as I have already suggested, the usage of poetry should not be imitated in prose, least of all in technical writing, in which precision is imperative.

'Which' is not inflected; it refers usually to things only, not to persons. 'That' also is not inflected; it refers to both persons and things; it cannot be modified directly by a preposition. We do not say "The man in that we trusted", although colloquially we may say: "The man that we trusted in"—an awkward clause. To 'trust' a man and 'to put your trust in' a man express different shades of meaning. Therefore we decide to say "The man in whom we trusted", or, simply, "The man we trusted". Likewise we would not say "the house in that Holmes was born", nor would we care to say "the house that Holmes was born in", but "the house in which Holmes was born". Thus good usage leans to the side of euphony.

The use of 'that' for referring to persons is considered old-fashioned by many, even incorrect by some. Webster's dictionary defines a 'director' as "one that directs". The Century dictionary says "one who directs". My own experience leads me to agree with Webster. Here 'one' stands for 'the kind of person'; it is specific, not general. I would say

(9) "The man that said so is worthy of respect", and not "The man *who* said so, etc."

As we shall see later, 'that' should introduce a definitive clause. It is generally conceded to be required when a superlative is attached to the antecedent:

(10) "The most careful man that I could find."

"He was the greatest geologist that ever lived."

'That' is also preferred with a word of exclusive or comprehensive meaning, such as 'only' or 'any'. Thus:

(11) "The only mineral that I recognized."

"Anybody that goes this way is in danger."

The use of 'and which' presents another difficulty to young writers—and old ones too. This phrase should not be employed unless it is preceded by another subordinate clause introduced by 'which'. It is correct to say:

(12) "He went to the Hercules mine, which he examined and which he hopes to buy."

It is not proper to say:

(13) "This is the kind of cyanide I prefer, *and which* I expect to use in the mill."

Here 'which' should be deleted, and 'it' inserted after 'use'. An alternative would be to delete 'which' and the second 'I', as well as the comma, thus: "This is the kind of cyanide I prefer and expect to use in the mill."

(14) "It may be possible to operate profitably a small plant using shale conveniently situated *and which* can be mined at a low cost."

"It may be possible to operate profitably a small plant if it is supplied from a deposit of shale so situated as to be mined cheaply."

The chief difficulty is to discriminate between the use of 'that' on the one hand and of 'who' or 'which' on the other. Most writers seem to consider 'that' and 'which' interchangeable; therefore they employ 'that' as an agreeable variant of 'which', and get into trouble. Since 'that' also plays the part of a conjunction, an adverb, and a demonstrative pronoun, they prefer 'which' to 'that' when choice appears permissible.

I shall take special pains to discuss the uses of 'that' and 'which' because my own experience has caused me to appreciate keenly how necessary it is to have a thorough under-

standing of the distinctive functions of these pronouns. The main distinction is this:

THE FUNCTION OF 'THAT' IS TO DEFINE AND TO RESTRICT;
THE FUNCTION OF 'WHICH' IS TO EXPLAIN AND TO SUPPLEMENT.

At this point I am in honor bound to inform you that several authorities hold a different opinion; but I must add emphatically that in the course of my work as an editor of technical manuscript, and in revising my own writing, I have been impressed by the fact that the observance of this rule, regulating the use of 'that' and 'which', tends to clearness of expression.

(15) "This is the house that Jack built."

The words 'that Jack built' restrict or limit the meaning of 'house'; the sense is not complete without them; therefore 'that' is the pronoun to be used here, in accordance with the general rule that if the relative clause is clearly essential to the meaning of the statement—that is, if it limit or define the antecedent noun—'that' should be used, and not 'which' or 'who'.

Another familiar example of the restrictive use of the pronoun 'that' is furnished by

(16) "The man that has plenty of good peanuts."

On the other hand, the supplementary or explanatory clause requires 'which'; for example:

(17) "Dogs, which of all animals are most friendly to man, sometimes bite their masters."

(18) "Houses, which are made to live in, should be built with a view to comfort."

In these examples the relative clauses have a logical relation to the principal statement; they are explanatory and supplementary to that statement.

(19) "The mill, which was quite new, was destroyed by the snow-slide."

Here 'which' introduces a secondary statement, supplementary to the main one, which asserts the principal fact concerning the destruction of the mill. If 'that' had been used, the idea conveyed would be that one mill out of several, namely,

the newest of them, had been destroyed. Here 'which' is correct. The commas mark the beginning and the end of the interjected clause.

Relative clauses, as I have said, are divisible into 'defining' and 'non-defining'. The function of the defining clause is to limit the antecedent, which is the noun or clause to which the relative pronoun refers; it may express limitation in several ways; but whichever way it may perform its work, it is essential to and inseparable from the antecedent.

(20) "A process that will extract both metals will be adopted."

Here the clause "will extract both metals" is introduced by 'that' because it defines "the process". Remove the defining clause ("that will extract both metals") and nothing remains; to say "a process will be adopted" means nothing.

(21) "The process, which is of recent invention, extracts both the gold and the silver at a low cost."

Here the clause "is of recent invention", introduced by 'which', is non-defining; it is a bit of incidental information and can be omitted without affecting the principal statement concerning the extraction of "both the gold and the silver at a low cost".

(22) "The flotation process which is no longer in the experimental stage can be applied to an ore of this kind."

Here the clause introduced by 'which' can be lifted without spoiling the sense, because it merely introduces supplementary information. Commas should be used before 'which' and after 'stage'; otherwise the sentence is unorganized.

The best test for distinguishing between the two kinds of relative clauses is essentiality. The non-defining clause may serve in a measure to define or to limit by reason of its descriptive nature; so also the defining clause may contribute toward comment or explanation; but the test of being essential can be met only by the defining clause; the information given by it must be taken at once, or both it and its antecedent are useless.*

* See 'The King's English'; p. 79.

A simple rule for the use of 'that' and 'which' is given by Alexander Bain, and commended by Edwin A. Abbott in his little guide-book, 'How to Write Clearly'. The rule is: "When using the relative pronoun, use 'who' and 'which' where the meaning is 'and he', and 'and it', etc., 'for he', 'for it', etc. In other cases, use 'that' if euphony allows." Thus:

(23) "I heard this from the mine manager, who [and he] heard it from the man that was in charge of the work."

In this example 'that' cannot be replaced by 'and he', but the 'who' can. The clause following 'who' is continuative and supplementary, but the clause following 'that' is distinctly restrictive; it defines.

Abbott also says: "'Who' and 'which' introduce a new fact about the antecedent, whereas 'that' introduces something without which the antecedent is incomplete or undefined." Thus, in the above example, "I heard it from the mine manager" is a complete statement; 'who' introduces additional information concerning him, namely, his having heard about "this" from another man; but the phrase beginning with "the man" is incomplete without the distinguishing clause "that was in charge of the work".

Here is another good example:

(24) "I met the boatman *who* took me across the ferry."

If this should imply, "I met the boatman and he took me across the ferry", then a comma ought to precede the 'who' introducing the continuative clause, but if I am referring to the particular boatman by whose help I had crossed, I ought to say:

"I met the boatman that took me across the ferry."

Hodgson makes a similar distinction; he says that 'who' and 'which' should connect two co-ordinate sentences, whereas 'that' should be restrictive, limiting, and defining. Thus: "Margaret Finch, who died in 1740, was 109 years old" may be divided into two co-ordinate clauses, accordingly: "Margaret Finch died in 1740, and was 109 years old." But "Blessings on the man that invented sleep" can no more be resolved into

two sentences than can "Blessed be the inventor of sleep". The use of 'who' without a comma as in "Blessings on the man who invented sleep" is saved by the continuation of the sense.

Let me suggest another simple test: a clause introduced by 'who' or 'which' usually should be set off by commas. Correct punctuation indicates that the clause is supplementary. If the commas spoil the sense, 'that' should be substituted or the sentence should be re-written. Again, 'who' or 'which' usually refers to the word immediately preceding, but 'that' may throw the reference back to a word or an idea earlier in the statement. Thus:

"The Trail smelter is treating ore from the Sunshine mine that assays only \$6.10 per ton."

The assay refers to 'ore', not 'mine.'

(25) "A party of soldiers from Camp Douglas *were* [was] guarding some horses belonging to the garrison *which* [that] had been sent to graze in Bingham canyon."

So writes a historian. It was the 'horses', not the 'garrison', that had been sent to graze, and the use of the correct pronoun makes this clear.

(26) "I quote from Sir J. J. Thomson's 'Discharge of Electricity through Gases', who made a thorough investigation."

The 'who', coming after the name of the treatise, fails to throw the reference back to Thomson. A re-arrangement is required, thus:

"I quote from 'Discharge of Electricity through Gases' by Sir J. J. Thomson, who made a thorough investigation."

(27) "The defunct American Bank of Alaska, at Fairbanks, owns a number of claims on this creek, *which* fell into its hands for money loaned."

If the creek fell into its hands, as is asserted, the stocks held by the bank must have been much watered. The 'which', being preceded by the comma, ties the reference to the immediately preceding word 'creek', although the reference should be thrown back to 'claims'. Substitute 'that' for 'which' and delete the comma.

(28) "Resolved, that drinking places, *which* are haunts of vice, are dangerous and should be eliminated."

This resolution was submitted at a brewers' convention. They did not mean that all public drinking-places were "haunts of vice". They meant to "eliminate" only such drinking-places as were haunts of vice. The clause was meant to be restrictive, but the substitution of 'which' for 'that' made it continuative.

In describing plant or machinery, which consists of a number of correlated parts; likewise in describing a process, which consists of inter-dependent operations, it is necessary to define, to specify the part played by each member of the series, and to make clear the relation of one to the other. In order to accomplish this purpose, the relative pronouns must be used discriminatingly. For example, in describing a mill for concentrating copper ore:

(29) "The rolls discharge into a wire screen, the mesh being varied from 1 to 1½ in. according to the proportion of moisture, which ranges from 5 to 13%. The undersize is carried to the conveyor that serves the preceding screen, while the oversize goes to an elevator which takes it to a fourth set of screens, similarly adjusted."

The 'that' serves to introduce a defining clause essential to the description. The first 'which' introduces a secondary item of information. The second 'which', after 'elevator', is equivalent to 'and it'; the clause is continuative.

Here is the description of a filter for de-watering concentrate:

(30) "It consists of a revolving drum on which is stretched a porous medium of canvas that is immersed in the concentrate during a part of the revolution, the concentrate being drawn to the canvas by the action of a vacuum induced within the drum so as to suck the pulp, which, becoming de-watered, is detached by compressed air, releasing the vacuum."

The immersion of the canvas is essential. The 'which' can be replaced by 'and it'.

Many of our best writers and speakers ignore the distinction

between 'that' and 'which', deeming it a matter of euphony only. In consequence, they fail to express themselves clearly. In a speech of international importance, Mr. Lloyd George, the British Premier, said:

(31) "Nor are we fighting to destroy Austria-Hungary or to deprive Turkey of its capital, or of the rich and renowned lands of Asia Minor and Thrace *which* are predominantly Turkish in race."

This means that the Allies are not fighting to deprive Turkey of Asia Minor and Thrace. Mr. George appears to give the supplementary information that these two regions are "predominantly Turkish in race". What he means to say is that the Allies are not fighting to deprive Turkey of the Asiatic and Thracian lands that are predominantly Turkish in race, such as Turkey proper and Anatolia, but they do expect to end Turkish misrule in Arabia, Armenia, Mesopotamia, Syria, and Palestine.

President Wilson is a skilful writer, and he appears to appreciate the defining function of 'that' most of the time, but not always:

(32) "The German government denies the right of neutrals to use arms at all within the areas of the sea *which* [that] it has prescribed, even in the defence of rights *which* [that] no modern publicist has ever before questioned their right to defend."

In the above quotation, both of the clauses introduced by 'which' restrict and define, therefore 'that' is preferable. It makes the statement clearer and stronger.

The Council of National Defense is responsible for the following:

(33) "If you do not own a smelter, may we ask you to instruct the smelter *which* [that] smelts your ores to furnish one-sixth of the lead-content of the ore *which* [that] it accepts from you in July on the Government order and notify them that you will accept in settlement for that amount of lead in your ore the price that the Government is paying."

The first 'which' should be replaced by 'that' because it

introduces a restrictive clause; so also the second 'which', for the same reason. The first 'that' in the quotation is a conjunction, the second is a demonstrative pronoun, and the third is a relative pronoun (used this time correctly, instead of 'which') introducing a defining clause. Each 'that' is employed correctly, but they are crowded unhappily. The entire statement is infelicitous. The word 'smelter' is used first to signify a metallurgical plant and then to signify the manager or the owner of such a plant. To whom does 'them' refer? Presumably the owners of the smelting plant.

(34) "They could take anything in Russia, *which* they considered worth the trouble. The Russians can never drive them out of the vast stretches of Russian territory *which* they now occupy." 'The New Republic'.

Delete the comma before the first 'which' and substitute a 'that'. The second 'which' is not needed.

John Graham Brooks says:

(35) "One of the most careful of our critics who studied us for three years felt this danger."

How many of these critics studied us for three years? 'Who' can be replaced by 'and he'. The sentence can be better organized, thus: "A most careful critic, who studied us for three years, felt this danger."

Sidney Colvin, in the 'Introduction' to 'The Letters of Robert Louis Stevenson', says:

(36) "Once more, it may be questioned whether among the many varieties of work *which* [that] Stevenson has left, all touched with genius, all charming and stimulating to the literary sense, all distinguished by a grace and precision of workmanship which are the rarest qualities in English art, there are any *which* [that] can be pointed to as absolute masterpieces, such as the future cannot be expected to let die."

The "precision of workmanship" of Stevenson's literary executor suffers, I think, by the use, twice, of 'which' for 'that', because in each case the pronoun introduces a defining clause. The second 'which' is correct.

In contrast, permit me to quote an eloquent and informing sentence by Charles M. Gayley, who, in 'Shakespeare and The Founders of Liberty in America', describes Richard Hooker thus:

(37) "In Sandys and Shakespeare we recognize the religious ideal of freedom tempered by reverence, the political ideal of liberty regulated by law and conserved by delegated authority, the moderation, tolerance of divergent opinion, the broad and sympathetic confidence in progress rather than in rigidity or finality, that are characteristic of the most philosophical writer upon politics, the broadest minded, most learned, and most eloquent divine of sixteenth-century England."

Note how the five antecedent clauses are introduced by 'that' so as to accentuate the completeness of the description. This fine utterance would have been wrecked by the use of 'which', weakening the keystone of this symmetrical literary arch to the memory of the great philosopher of the Shakespearean epoch.

There is an exception to every rule. Your comprehension of a rule will be tested by recognizing the exception, for it is then that you learn how to follow the spirit of the rule intelligently, not mechanically. 'That' is not available for all restrictive clauses, for in some of them the conjunction 'that' may lead to an awkward repetition of the word. For instance,

(38) "He said *that* he had examined a mine in the Leadville district *which* is in a position to furnish large quantities of manganese."

'Which' should be replaced by 'that'; in consequence, the conjunction 'that' would be too near the pronoun 'that'. This would be awkward. Delete the first 'that', because it will be understood; also re-cast the introductory clause thus: "He spoke of having examined a mine, etc."

Whenever a sentence appears doubtful in the light of any rule, it is probable that the sentence, not the rule, needs changing. When in doubt, re-build the sentence.

(39) "Jones, who was one of the men *whom* [that] I brought

from Colorado, would not leave his work, which ensured the completion of the job *which* [that] I had much at heart."

The 'whom' and the second 'which' can be deleted, and the latter half of the statement changed, thus:

"Jones, who was one of the men I brought from Colorado, would not leave his work; thus his fidelity ensured the completion of a job I had much at heart."

(40) "A pipe-line therefore is laid down the shafts, *which* carry water to sprays set under the timbers."

This refers to protection from fire underground. The 'shafts' do not "carry water to the sprays"; the reference is to the 'pipe-lines'. The relative pronoun is not required.

"A pipe-line therefore is laid down each shaft, to carry water for sprays set under the timbers."

(41) "In the mountains of the State there are hidden rare minerals, besides gold, copper, and silver, *which* are able to produce some of the metals most needed in the iron and steel industries."

The 'which' refers to 'rare minerals', not to 'gold, copper, and silver':

"In the mountains of the State are to be found not only ores of gold, silver, and copper, but also minerals that might yield some of the rare metals needed in the iron and steel industry."

(42) "There were very few miners, *who* escaped without serious injury."

This might be resolved into "and all escaped", whereas if 'that' had been used, without the comma, the truth would have been stated, namely, "Almost all the miners were seriously injured" or "Only a few miners escaped serious injury".

The foregoing examples serve to illustrate the advantage to be gained by re-writing an awkward or ambiguous sentence. A doubtful meaning is worse than a grammatical error. Do not hesitate to re-build the sentence if it seem unsafe.

(43) "Hoisting was done through the centre compartment only, by means of two 15½-cu. ft. buckets used alternately

and dumped automatically on top into the car by means of a chain hung from the head-frame *which* was hooked into a ring on the bottom of the bucket holding the bottom stationary and allowing it to tip on an incline-door and chute, thereby discharging its contents."

The head-frame was not hooked to the bottom of the bucket! 'Which' refers to the chain. Splitting into two sentences and proper punctuation will clarify the meaning, thus:

"Hoisting was done through the central compartment only, by means of two 15½-cu. ft. buckets, which were used alternately and dumped automatically at the surface into a car by means of a chain hanging from the head-frame. This chain was hooked to a ring on the bottom of the bucket so as to hold it stationary while it was being discharged upon an incline-door and chute."

Here 'which' introduces a supplementary statement, followed by further information.

(44) "The road vibration alone will loosen nuts and rivets, *which* if not attended to in time will cause serious trouble."

The road does not vibrate; it is the motor-truck, to which the statement refers, that vibrates. The 'which' does not refer to 'rivets' but to 'loosen'. Re-cast the entire statement, and avoid the preposition-verb 'attended to', thus:

"The vibration of the truck while on the road will loosen the nuts and rivets; and this, if neglected, will cause serious trouble."

The last example again serves to show that it is best not to tinker with a bad sentence, but to re-write it. By so doing you not only make a useful correction, but you learn to improve your composition. Mistakes, when corrected, become stepping-stones to the attainment of skill in writing, as in life generally.

It may seem that I have laid excessive stress on the distinction between the relative pronouns, particularly as it must be granted that the practice of reputable authors is indiscriminate. So good a teacher as Professor Hill says that "in

this matter the ear is a surer guide than any theory", and he imputes the use of 'that' in such lines as

(45) "Hearts that once beat high for praise" (Moore)

"Thoughts that breathe and words that burn" (Gray)

not to any grammatical theory but to euphony, because " 'that', following without intervening pause a plural noun ending in 's', is easier to speak and more agreeable to hear than 'which' would be".* But to this I must demur; the 'thats' in these quotations are doing their duty. Sense should not be sacrificed to euphony, particularly in technical writing, in which grace of diction is frankly subordinated to clearness and precision. Take the following example:

(46) "The company will erect a plant to treat the residues *that* were not saleable during the War."

The 'that'—let us suppose—is used for the sake of euphony, to avoid collision between 'which' and the final 's' in 'residues'. The statement now means that a plant is to be erected for the treatment only of such residues as were unsaleable during the War, whereas the writer meant to say, and would have said it if he had used 'which', with a comma, that all the residues were unsaleable and were to be treated locally in the company's new plant.

James P. Kelley† quotes Hill as having defined 'ease' as the "quality *which* makes language agreeable", but on the next page he himself writes: " 'The quality *that* makes language agreeable' manifests itself in many ways." He adds: "The writer *who* goes to work to exhibit the pleasing features of his style is on dangerous ground; let him beware lest he violate the first principle of ease." It was to 'ease' perhaps that he sacrificed the 'that' after "writer", and to euphony that we owe his use of it in the next quotation, given herewith:

(47) "He *that* doesn't care will never learn to write; and he *that* cares will 'take suggestion as a cat laps milk'." "He *who*" repeated would suggest the braying of an ass.

* A. S. Hill, *Op. cit.* Page 126.

† In 'Workmanship in Words', a stimulating textbook.

No; euphony is too uncertain a guide for the technical writer; it may cajole him into ambiguities not to be risked in the serious work he has in hand. He is more likely to attain clearness of style if he will make up his mind whether he intends to define or to comment, using 'that' for the first purpose, and 'who' or 'which', with commas to set off the commenting clause, for the second purpose.

It may be argued that because the great masters of our language are inconsistent in their use of 'that' and 'which', therefore it is not for technical writers to attempt to make the distinction. I think it is, if we can increase the clearness of our expression thereby. For instance, Ruskin says: "Out of the infinite heap of things around us in the world, human invention chooses a certain number *which* it can thoroughly grasp, and presents this group to the spectator in the form best calculated to enable him to grasp it also, and to grasp it with delight." This is the writing of a past-master, yet, I suggest, "which" introduces a defining clause and therefore should give place to 'that'. He is explaining how human invention chooses a small number of things out of a heap of things, and it chooses to select the particular things it can grasp thoroughly; therefore 'that' is preferable; it expresses the meaning more clearly than 'which'. Let it be noted, moreover, how Ruskin avoids the unnecessary 'thats' and 'whiches', as, for example, in the introductory sentence in the above quotation, where he might have written: "Out of the infinite heap of things *that are* around us in the world". Most of us use these relative pronouns too much, creating needless difficulties for ourselves. I am tempted to quote Ruskin further, partly because the quotations are delightful in themselves, but mainly to show how his indifference to the distinction between 'that' and 'which' is a defect in his splendid writing. I shall quote from the fourth volume of 'Modern Painters' because it deals with geology. He speaks of the motion given to water by the mountains:

(48) "Every fountain and river, from the inch-deep stream-

let *that* crosses the village lane in tumbling clearness, to the massy and silent march of the everlasting multitude of waters in Amazon or Ganges, owe their play, and purity, and power, to the ordained elevations of the earth. Gentle or steep, extended or abrupt, some determined slope of the earth's surface is *of course* necessary, before any wave can so much as overtake one sedge in its pilgrimage; *and* how seldom do we enough consider, as we walk beside the margins of our pleasant brooks, how beautiful and wonderful is that ordinance, of which every blade of grass *that* waves in their clear water is a perpetual sign; that the dew and rain fallen on the face of the earth shall find no resting-place; shall find, on the contrary, fixed channels traced for them, from the ravines of the central crests down which they roar in sudden ranks of foam, to the dark hollows beneath the banks of lowland pasture, round which they must circle slowly among the stems and beneath the leaves of the lilies; paths prepared for them, by which, at some appointed rate of journey, they must evermore descend, sometimes slow and sometimes swift, but never pausing; the daily portion of the earth they have to glide over marked for them at each successive sunrise, the place *which* has known them knowing them no more, and the gateways of the guarding mountains opened to them in cleft and chasm, none letting them in their pilgrimage; and, from far off, the great heart of the sea calling them to itself!"

He uses 'that' twice to introduce a restrictive clause, but he also uses one 'which' for a precisely similar purpose. Is it not preferable to say, "the place *that* has known them"? The "of course" is a blemish; the statement in which it appears is no more self-evident than many others in the same paragraph; it mars the dignity of the diction. Delete the "of course" and the comma after "necessary". Note how skilfully he uses "down which", "round which", and "by which", in sequence, to describe the course of the water. Note also the effectiveness of the two 'ands', in "their play, and purity, and power", to emphasize the manifold consequences of nature's ordinance;

but he uses too many 'ands', for instance, the one before "how seldom", where he joins two separate ideas.

Here is another fine passage to show the use of these troublesome pronouns. He is speaking of the beauty of the district between Valorsine and Martigny.

(49) "The paths *which* lead to it out of the valley of the Rhone, rising at first in steep circles among the walnut trees, like winding stairs among the pillars of a Gothic tower, retire over the shoulders of the hills into a valley almost unknown, but thickly inhabited by an industrious and patient population. Along the ridges of the rocks, smoothed by the old glaciers into long, dark billowy swellings, like the backs of plunging dolphins, the peasant watches the slow coloring of the tufts of moss and roots *which*, little by little, gather a feeble soil over the iron substance; then, supporting the narrow strip of clinging ground with a few stones, he subdues it to the spade; and in a year or two a little crest of corn is seen waving upon a rocky casque. The irregular meadows run in and out like inlets of lake among these harvested rocks, sweet with perpetual streamlets, *that* seem always to have chosen the steepest places to come down, for the sake of the leaps, scattering their handfuls of crystal this way and that, as the wind takes them, with all the grace, but with none of the formalism, of fountains; dividing into fanciful change of dash and spring, yet with the seal of their granite channels upon them, as the lightest play of human speech may bear the seal of past toil."

This "play of human speech" is so exquisite that it is safe to infer the toil of the true artist. Note the imagery: the paths like "winding stairs"; the rounded rocks like "plunging dolphins"—the porpoises of unpoetic fact; "the crest of corn upon the rocky casque"; the meadows "like inlets of lake among the harvested rocks". Note also the large proportion of simple Anglo-Saxon words, rendering the few Latin words particularly effective. But what of the 'thats' and 'whiches'? The first 'which' should be replaced by 'that' because it introduces a definition of "the paths", namely, those leading to this district

from the Rhone. The second 'which' is acceptable, because it introduces a descriptive clause, not essential to the argument. However, a comma is needed before it, to supplement the semicolon after it. The first, and only, 'that' should be replaced by a 'which', because it introduces a supplementary clause, not a defining or restrictive clause. Moreover, the use of 'which' would be acceptable because it would avoid the repetition of 'that' three lines lower. However, 'which' might be unpleasant between "streamlets" and "seem". Ruskin was writing something akin to poetry, and may be deemed beyond the criticism that applies to technical writing, which is endangered by listening for euphony.

These quotations suffice to illustrate how Ruskin ignored the distinction on which I have ventured to lay stress. Other skilful users of English show the same disregard; for example, Huxley. He is speaking of the formation of coal:

(50) "When the fallen trunks *which* have entered into the composition of the bed of coal are identifiable, they are mere double shells of bark, flattened together in consequence of the destruction of the woody core; and Sir Charles Lyell and Principal Dawson discovered, in the hollow stools of coal trees of Nova Scotia, the remains of snails, millipedes, and salamander-like creatures, embedded in a deposit of a different character from that which surrounded the exterior of the trees. Thus, in endeavoring to comprehend the formation of a seam of coal we must try to picture to ourselves a thick forest, formed for the most part of trees like gigantic club-mosses, mares-tails, and tree-ferns, with here and there some *that* had some resemblance to our existing yews and fir-trees. We must suppose that, as the seasons rolled by, the plants grew and developed their spores and seeds; that they shed these in enormous quantities, *which* accumulated on the ground beneath; and that, every now and then, they added a dead frond or leaf; or, at longer intervals, a rotten branch, or a dead trunk, to the mass."

This is quoted from one of his popular lectures, revised before publication, of course, but still not an example of his

most finished style. Nevertheless, it illustrates his power as an expositor of science to the unlearned.

Three relative pronouns are used, besides the compound "that which". This obviously is necessitated by euphony. Even when the two pronouns, one demonstrative and the other relative, are separated we use 'that which' instead of 'that that'. Likewise by analogy most writers prefer 'those which' or 'those who' to 'those that'; thus:

(51) "In those low-grade mines which call for rigid economy."

Returning to our quotation from Huxley; the first 'which' introduces a restrictive clause. It is true, by placing a comma before "which" and after "bed of coal", the clause could be treated as supplementary and descriptive, because Huxley had previously introduced the idea of coal being formed from fallen trees, but in the opening sentence of this paragraph he is undoubtedly defining the "fallen trunks" as the subject under discussion. The 'that' before "had some resemblance" is acceptable, for it is followed by a restrictive clause. The second 'which' likewise is correct, for it introduces a supplementary and non-essential bit of information.

I shall quote from Huxley again, and from the same 'lay sermon':

(52) "Let us suppose that one of the stupid, salamander-like Labyrinthodonts, *which* pottered, with much belly and little leg, like Falstaff in his old age, among the coal-forests, could have had thinking power enough in his small brain to reflect upon the showers of spores *which* kept on falling through years and centuries, while perhaps not one in ten million fulfilled its apparent purpose, and reproduced the organism *which* gave it birth: surely he might have been excused for moralizing upon the thoughtless and wanton extravagance *which* Nature displayed in her operations. But we have the advantage over our shovel-headed predecessor—or possibly ancestor—and can perceive that a certain vein of thrift runs through this apparent prodigality. Nature is never in a hurry, and seems to have had

always before her eyes the adage, 'Keep a thing long enough and you will find a use for it'. She has kept her beds of coal many millions of years without being able to find much use for them; she has sent them down beneath the sea, and the sea-beasts could make nothing of them; she has raised them up into dry land, and laid the black veins bare, and still, for ages and ages, there was no living thing on the face of the earth *that* could see any sort of value in them; and it was only the other day, so to speak, that she turned a new creature out of her workshop, *who* by degrees acquired sufficient wits to make a fire, and then to discover that the black rock would burn."

Six relative pronouns appear. The first calls for no remark; it introduces a bit of unessential, but delightful, description concerning the labyrinthodonts—they "pottered with much belly and little leg, like Falstaff in his old age". The second 'which' begins a restrictive clause, for, it seems to me, the words that follow, from "kept" to "birth" are essential to the statement, as is further suggested by the use of the definite article before "showers of spores". He is referring to showers of spores of a particular kind. The third 'which' undoubtedly should be replaced by 'that', for he defines the organism as the particular one from which the spore was born. The fourth 'which' might be omitted; if not, then it also should give place to a 'that', for it introduces a restrictive clause. The fifth relative pronoun is a 'that', as it should be; but if he uses it here why does he not use it where the previous 'which' appears? Evidently he employs them indiscriminately. Then comes a 'who', following "workshop", but with no reference to that word. By substituting 'that', and deleting the comma the sense is carried back to "new creature" and connected with the subsequent clause. He has used the conjunction 'that' immediately before and after 'who', so he might have preferred the latter for the sake of euphony; but it is more probable that he used 'who' in order to evoke the image of man's progenitor.

It will be noted that, in these quotations, Huxley uses 'and' too frequently. He might have employed other connectives.

The 'and' before "Sir Charles Lyell", in the first quotation, is particularly bad because he uses it to join two discrete ideas; moreover, he is compelled to use another 'and' immediately afterward to link the names of the two geologists. The writings of these great men are not immune from criticism, which neither lessens our appreciation of their skill nor diminishes our enjoyment of their work.

The reading of the best writings suggests that the general rule for the use of 'that' to introduce clauses expressing an essential limitation, restriction, distinction, or definition is subject to exception; it includes locutions that are unacceptable. In attempting to further the cause of precision, we must not offend unnecessarily against usage that is old, honored, and persistent. As the word 'that' plays the part not only of a relative pronoun, but also of a demonstrative pronoun, an adverb, and a conjunction, it is desirable to spare it. Evidently sub-rules are needed. These can be found by analyzing the best writings. We have seen how an occasional 'that' can be dropped without harm. "A house not built by hands" has precision, conciseness, perspicuity, and dignity in greater degree than the alternative form, "A house *that is* not built by hands". I venture to suggest four sub-rules:

(A) When the antecedent and the subject are brought together so that misunderstanding is impossible, as in the sentence just quoted, it is well to omit the 'that'.

(B) When the indefinite article precedes the subject [for example, "a person"], the pronoun 'who' or 'which' should introduce the subsequent clause [for example, "whom you are anxious to persuade"]; but when the definite article is used ["*the* person"], the pronoun 'that' should be employed to introduce the subsequent clause ["that you are anxious to please"].

In the first example, "a person" is not an individual but the representative of a group; in the second, the reference is to an individual to whom, or for whose sake in particular, something is to be done. Every relative clause tells something about the noun in the antecedent clause, and, therefore, in a

sense, is adjectival; it serves in one way or another to describe, and by so doing to suggest restriction; yet it may not distinguish or particularize; it may not point to it as necessarily the one thing of its kind in the world to which reference is being made. Then 'which' is preferable. When, on the contrary, the idea of another thing with the same name is implicit, and the subsequent clause says in effect, 'This is the one I am talking about, not any of the others', then 'that' is demanded.

(53) "The police captured a thief who had a mole on the end of his nose, an ear missing, six toes on his left foot, and, whose thumb-print belonged to subdivision 67 of class G."

There may have been no trouble in identifying him, yet the clause giving all this information begins properly with 'who'. On the other hand: "The police caught the thief that they sought" points to one only; it separates him from others more completely than all the ear-marks given in the preceding quotation.

(C) When a person or thing has been mentioned previously and designated as possessing some quality that differentiates him or it from others of his or its class, then 'who' or 'which' is preferable to 'that' in beginning a clause designed to recall the quality. "The Denver editor, who was contemptuous of the effort to write well, ignored this rule." My previous mention of him, as the man that wanted "to get there" in his own slipshod way, made it unnecessary to identify him; therefore the clause after 'who' is a supplementary clause, by way of reminder only.

(D) The relative clause ceases to introduce a necessary definition whenever the antecedent has been defined by a possessive pronoun; therefore 'who' or 'which' should replace 'that'.

(54) "My brother, who enlisted two years ago, has returned from France."

(55) "Our methods, which may commend themselves to you, are the product of long experience."

The relative pronouns are used far more than is necessary,

and the lavish use of them invites needless trouble for both the writer and the reader. Several substitutes are available.

(a) When the relative pronouns have led you into a verbal entanglement, cut loose, and start again with 'and this'.

(56) "He enlarged the mill, *which* enabled him to lower the cost per ton."

It were better to say:

"He enlarged the mill, and this enabled him to lower the cost per ton."

(b) Another means of escape from a choice of relative pronouns is to begin a new sentence with a semicolon followed by 'this'; for example:

(57) "He enlarged the mill; this enabled him to lower the cost per ton."

(c) The defining clause can be replaced by the present participle, but be sure you have a noun for it!

(58) "I have seen an Australian gold ore that resembles *this*."

"That resembles" can be replaced by "resembling".

(d) The infinitive is a common substitute, thus:

(59) "He was the first *that succeeded* [to succeed]."

(60) "This is not a man *that will save* [to save] money."

(e) The relative pronouns are used often to introduce a clause giving a reason, whereas the explanatory clause should begin with 'since', 'because', or 'although'.

(61) "The company is about to erect a leaching-plant for the silver-tin concentrate *for which* [because] it did not find a remunerative market [for it] either in England or Germany."

(62) "Mines, which are usually regarded as sources of wealth, are often the cause of much financial loss."

Here 'which' can be replaced by 'although', with a rearrangement of the sentence, thus:

"Mines are often the cause of much financial loss, although they are usually regarded as sources of wealth."

(64) I wrote, "Delete the first 'that', which will be understood." Later I substituted 'because it' for the 'which'.

(f) 'By which', 'in which', and other awkward locutions can be replaced by 'whereby' and 'wherein':

(65) "The method *by which* [whereby] this result can be achieved."

(66) "It is a process *in which* [wherein] the nicest chemical adjustment is essential."

I have drawn attention already to the occasional omission of the relative pronoun as favorable to perspicuity rather than to obscurity. Landor, in his 'Imaginary Conversations', makes Horn Tooke quote Cato, after Middleton:

(67) "The high office *which* you fill and the eminent distinction *that* you bear."

To which Dr. Johnson replies:

"Much better without both 'which' and 'that'."

Later Tooke says: "The rejection of 'that' in the proper place is a cause of peculiar elegance, for it bears heavily on our language. The Romans were fortunate to avoid it by means of the infinitive of their verbs."

(68) "He said *that* he would be glad to accept the appointment."

'That' can be omitted.

(69) "Sulphide ores *which* [that] *have* [had] been previously untouched were shipped in large quantities."

Why fuss about the relative pronouns needlessly? State simply:

"Sulphide ore previously untouched was shipped in large quantity."

Note the superfluous plurals; he was referring to only one kind of sulphide ore.

(70) "It follows that the liquids *which* are near their critical point will have small surface-tensions."

'That' should replace 'which'; but neither is needed. When corrected, the statement would read as follows: "It follows that liquids when near their critical points will have small surface-tensions."

(71) "Substantial evidence is at hand *which* goes to

show that floatable minerals have the positive sign of electricity."

'Which' should be 'that', because it introduces a defining clause, but the change would bring the relative pronoun 'that' close to the conjunction 'that', and this would be awkward. So it were better to say:

"There is ample evidence to show that floatable minerals have the positive sign of electricity."

"To hand" is a frill; if the evidence is known, it is 'to hand'. "Substantial" may be a synonym for 'important' or 'strong', or 'actual', as opposed to illusory. It is a mistake to use a word of many meanings without indicating the particular one intended. REMEMBER THE READER. Also remember that all rules must give way to the main objective, which is to make oneself understood beyond a doubt. If a sentence fails in this purpose, however correct grammatically, re-arrange it. Re-consider what you want to say and start again. Don't tinker with defective writing, for by so doing you run the risk of retaining one of the defects. Good writing calls for care—persistent care; it calls for a literary conscience that refuses to be satisfied with unfinished work.

Kelley says: "There be not many so well born, well trained, and well read, and withal so informed with the spirit of goodness and beauty, as to be effectually called to the higher ranges of literary expression; and even for such there is no short and easy road—though there is indeed a royal road—to their destination. But there are, and will continue to be, countless writers of higher or lower degree who ought to do their work far better than they have done it, and far better than ordinary writers have ever done it. For all such it is important that they should at least know what to avoid; and knowing what to avoid is in effect knowing what to aim at and what to strive for. To trained workmen I do not profess to give instruction; but because in my own experience to have my attention called to an error has been so often the beginning of an effort henceforth to avoid it, I have confidence that any

other sincere workmen will be interested and helped if I make them think of faults to which they have paid little attention hitherto."

I quote this with keen pleasure because Mr. Kelley says, better than I can, what I would like to say.

VIII. PREPOSITIONS AND PREPOSITION-VERBS

The function of a preposition is to indicate the relation of one thing to another; it is necessary therefore to select the preposition that suggests that relation. Such selection will be controlled by the requirements of the context and by idiomatic usage.

(1) D'Israeli says: "The conversations of men of letters are of a different complexion *with* the talk of men of the world."

"The conversations of men of letters are of a complexion different *from* that of the talk of men of the world."

(2) Hallam says: "This inspired so much apprehension *into* printers that they became unwilling to incur the hazard of an obnoxious trade."

"This inspired printers *with* such apprehension that etc."

(3) A. C. Benson says: "I want to learn to distinguish *between* what is important and unimportant, *between* what is beautiful and ugly, *between* what is true and false."

One does not distinguish 'between' what is beautiful and ugly or 'between' any other single thing; one does distinguish between what is beautiful and what is ugly; but what he really wanted to do was to distinguish the beautiful *from* the ugly, the true *from* the false.

(4) A physicist writes: "During the experiments a record was made *on* [of] the effect produced by various concentrations of sulphur di-oxide gas *on* [upon] the senses."

(5) A metallurgist writes: "The two kinds of flotation concentrate are conducted *through* [by] concrete launders to the elevators."

(6) An engineer says: "We must offer a protest *over* [against] this latest order."

The use of the appropriate preposition is essential to perspicuity. "One virtue of style is perspicuity", said Aristotle.

For example: 'to' denotes done, terminated, or finished; 'from' denotes beginning; and 'by' denotes agency.

Inside, outside, and alongside do not require an 'of' after them.

(7) "Alongside *of* this eccentric and disturbing force" 'The Saturday Review'.

(8) "Outside *of* the market for military uses, a premium can be obtained for electrolytic zinc."

(9) "The boat was moored alongside *of* the wharf."

In each case 'of' should be deleted.

A common error is to place 'of' after 'all', as in

(10) "All *of* the men refused to work."

(11) "He expected to roast all *of* the ore."

A mining engineer protests:

(12) "*Under* [in] these circumstances I refuse to agree to your proposal."

A veteran mining engineer reminisces:

(13) "Which led to my first introduction to that firm, the best known British firm in that country, *and whom* I subsequently returned to work *for in* after years, and have since kept *up* a close professional connection *with*."

Note the misplaced prepositions, ending the paragraph with one that is insignificant. The statement might be revised thus:

"Which led to my introduction to Brown, Jones & Co., which is the best known British firm in that country and one for which I worked in after years; indeed, I may say that I have maintained a close professional connection with Brown, Jones & Co. to this day."

The mention of the firm's name makes the statement clearer and more informing.

(14) A superintendent writes: "It was proposed to widen the blades 7 to 11 inches." If he means that the width is to be increased by more than 7 inches, he should insert 'by' after 'blades'; but if he means, as he does, that the width is to be increased from 7 inches, as it is now, to 11 inches, he should insert 'from' after 'blades'.

English idiom requires certain prepositions to follow certain nouns, adjectives, or verbs. The following list is far from complete, but it may prove suggestive and useful:

Abound <i>in</i>	Look <i>over</i> an account
Accord <i>with</i>	Look <i>for</i> a missing article
Account <i>for</i>	Need <i>of</i>
Acquiesce <i>in</i>	Necessity <i>for</i>
Adhere <i>to</i>	Overcome <i>with</i> fatigue
Adverse <i>to</i>	Overcome <i>by</i> entreaties
Averse <i>from</i>	Provide <i>for</i> the future
Agree <i>to</i> a proposal	Provide <i>against</i> the evil day
Agree <i>with</i> a person	Provide oneself <i>with</i> something
Capable <i>of</i>	Pursuant <i>to</i>
Capacity <i>for</i>	In pursuance <i>of</i>
Consist <i>of</i> (composition)	Ready <i>for</i> a journey
Consist <i>in</i> (definition)	Ready <i>with</i> an answer
Commence <i>by</i> doing something	Ready <i>at</i> arithmetic
Commence <i>with</i> an act	Reckon <i>on</i> a result
Commence <i>from</i> a point	Reckon <i>with</i> a contingency
Compare <i>with</i>	Reckoning <i>with</i> a person
Demand <i>for</i> a thing	Responsible <i>for</i> an action
Demand <i>of</i> a person	Responsible <i>to</i> a person
Differ <i>from</i>	Result <i>of</i> an examination
Different <i>from</i>	Result <i>in</i> a failure
Full <i>of</i>	Result <i>from</i> a previous event
Indifferent <i>to</i>	Satisfied <i>of</i> a fact
In view <i>of</i> facts	Satisfied <i>with</i> a little
With a view <i>to</i> doing something	Satisfaction <i>in</i> an improvement
Labor <i>under</i> a difficulty	Secure <i>from</i> harm
Labor <i>for</i> a person	Secure <i>against</i> attack
Labor <i>in</i> a good cause	Suited <i>to</i> the occasion
Labor <i>at</i> a task	Suited <i>for</i> a part
Live <i>for</i> riches	Tamper <i>with</i>
Live <i>by</i> labor	Tinker <i>at</i>
Live <i>on</i> an income	Vary <i>from</i>
Look <i>after</i> a business	At variance <i>with</i>
Look <i>at</i> a thing	Versed <i>in</i>
Look <i>into</i> a matter	Conversant <i>with</i>

Prepositions commonly transfuse something of their own meaning into the word with which they are compounded.

In technical writing it will be found that words of Latin origin help to make nice distinctions of meaning and establish the precision for which we strive constantly. The short and simple Anglo-Saxon may suit the poet's purpose, but the engineer will discover that many old-fashioned English words have associations and meanings unfitting them for his special use. This applies to the numerous preposition-verbs, which, idiomatic though they be, and an essential part of our language, should be avoided or used sparingly by the technical writer. They came into every-day use long before modern science was developed and they carry with them the looseness of meaning characteristic of colloquial speech. Note the following equivalents:

Call for	Demand, require
Carry out	Perform, conduct
Deal with	Treat, discuss
Decide on	Select
Do away with	Discard
End up	Conclude
Fall off	Decline, decrease
Go into	Investigate, examine
Go on with	Continue
Keep up	Maintain
Keep out	Exclude
Look for	Anticipate, expect
Look upon	Regard
Make up	Compose
Make use of	Utilize
Make up to	Compensate
Prove up	Confirm
Put in	Insert
Put up with	Endure
Refer to	Mention
Result in	Cause
Speed up	Accelerate, hasten
Try out	Test
Work out	Devise

(15) "As regards the miners, a much more serious prospect of social disaster had been, it was hoped, *done away with* [prevented or obviated]."

(16) "The various innovations were *tried out* [tested] before being used."

(17) "The company has been *meeting with* [obtaining] profitable results at Cochasayhuas."

As an editor I have become convinced that the excessive use of preposition-verbs is a serious obstacle to precision and clearness in writing. The habit of using them is more British than American, but it is an obstacle to perspicuous writing wherever the English language is spoken.

(18) 'Punch' published a series of cartoons to show 'What our artist has to put *up with*.'

The most cultivated of Englishmen trip over their prepositions, largely because they employ so many preposition-verbs, which require the most careful handling. For example, Arthur J. Balfour said:

(19) "There must be men in the House [of Commons] who see that of all the evils the Constitution can suffer *from* rash legislation is the most dangerous."

'To suffer from' is idiomatic—I cannot call it incorrect—but you will note the confusion caused by the misplacing of 'from'. In speaking, 'from' is pronounced immediately after 'suffer', leaving a slight interval before 'rash', but in reading 'from' appears linked to 'rash legislation'. He meant to say:

"There must be men in the House who see that of all the evils threatening the Constitution, the most dangerous is rash legislation."

I am aware, of course, that Shakespeare can be quoted in defence of such a placing of the preposition; for example:

(20) "What a taking was he *in* when your husband asked what was in the basket." 'Merry Wives of Windsor,' Act III, sc. 3.

(21) "I have a letter from her

Of such contents as you will wonder *at*." 'Merry Wives of Windsor,' Act III, sc. 6.

One can find examples of similar usage in the writings of Addison, Goldsmith, Jane Austen, Ruskin, and Stevenson, as

shown by Professor Hill*, no mean authority on correct usage; but, on examination, it will be found that the examples quoted usually represent colloquial expressions. In technical writing the preposition-verb does not give the precision required. Shakespeare's characters spoke naturally, so they spoke imperfectly. I can find no just warrant for quoting slips of conversation as guides for correct usage in deliberate writing. I prefer Professor Hill's conclusion: "A good author does not hesitate to put a preposition at the end of a sentence, when, on grounds of clearness, force, or ease, he thinks it belongs there; but often, perhaps usually, he finds that it belongs somewhere else." I submit that whereas sometimes the shifting of the preposition may contribute to ease it rarely ministers either to clearness or force.

(22) 'The Westminster Gazette' says, "One of the conclusions *at* which Lord Rosebery has arrived *at* in the study of Dr. Johnson is that he would have made a splendid journalist."

It seems to me that a "splendid journalist" would not have used his prepositions so carelessly. Delete the second 'at'.

(23) 'The Times' speaks of "the unflinching enthusiasm which Mr. Roosevelt has met *with*." It were better to say, "the unflinching enthusiasm with which Mr. Roosevelt has been received."

(24) E. F. Benson writes: "Lucia flicked *off with* the tassel of her riding whip a fly that her mare was twitching *its* skin to get rid *of*."

Evidently he forebore from writing 'her skin', because it might have suggested that the lady Lucia was being twitched.

(25) Hilaire Belloc, the military critic, writes: "First, as *to* the points the bombardment *of* which *from* the air one reads *of* almost daily in the present development *of* the aerial offensive *by* the Allies—which, *by* the way, is proving the increasing superiority *of* the allied air navies."

What a bombardment of prepositions!

* 'Beginnings of Rhetoric and Composition', by Adams Sherman Hill, pp. 489-490.

American authors make similar blunders; for example, William Dean Howells concludes an article thus:

(26) "This is the climax I have been working *up to*, and I call it a fine one; as good as a story to-be-continued ever ended an instalment *with*."

He makes a childish anti-climax by using an insignificant little preposition as his last word.

(27) A social reformer writes: "It is palpable that radical revision of laws, which have diverted so many millions of dollars into the pockets of the non-producing legal fraternity, is called *for*."

"There is palpable need for a radical revision of the laws that have caused so many millions of dollars to be diverted into the pockets of the unproductive legal fraternity."

(28) Robert K. Duncan writes: "It should be the young man's business to learn all the chemistry and cognate knowledge that he can lay his hands *upon in* the laboratory; and his brain alongside of *in* the study library."

Note how the prepositions become coupled awkwardly in this quotation, which is full of literary atrocities.

(29) An engineer writes: "The gold-mining industry which the Government looks *to* for its supply of gold."

The 'to' should precede 'which'.

A reviewer in the 'New Republic' begins a paragraph thus:

(30) "He had *met with* [found or seen], in China in 1803, an old commentary of one of the books of Confucius."

The six prepositions in this quotation tumble over one another in a heedless way; note the consecutive use of 'in' twice and of 'of' thrice.

C. W. Barron, in the 'Boston News Bureau', writes:

(31) "Governments in Europe are breaking *up*. Governments in Mexico are one after another breaking *down*."

Does he mean that the change from the Czar to the Bolsheviks is upward and from Diaz to the Villistas downward? *Quien sabe?* The feeble prepositions are burdened with too much philosophy.

President Wilson said recently:

(32) "One can feel sure that Franklin would have succeeded in any *part* of the national life that it might have fallen to his lot to *take part in*."

The use of 'part' in two different senses is confusing. He meant:

"One can feel sure that Franklin would have succeeded in any department of the national life."

The same distinguished writer said:

(33) "If there should be disloyalty, it will be dealt *with* *with a firm hand*."

'Dealt with' stands for 'punished'.

If the literati blunder so absurdly, it is no wonder that casual writers go astray; they use prepositions in order to intensify their verbs; for example, to 'test out', to 'win out'.

(34) "He tested *out* the process."

(35) "He is sure to win *out* in this competition."

I note that the other day Colonel House "sat *in with* the Big Four", and more recently I heard a man say: "Jones lost my umbrella *on* me."

A San Francisco newspaper recorded the fact that a bogus British peer had made the acquaintance of a soubrette on board ship coming from Honolulu. The reporter stated that the young man had "met up *with*" the young woman. Presumably to 'meet' a person is one thing; to 'meet *with*' him suggests more than a chance encounter; and to 'meet up *with*' him may be tantamount to a scandal in high life.

The New York 'Morning Telegraph' remarks:

(36) "When we first joined *out* with the Allies".

A common phrase is "to join *in* with"; the 'in' however has no meaning, and that is why, probably, the scribbler of the 'Morning Telegraph' substituted 'out', which also is redundant, if not worse. 'Out' suggests 'asunder', and therefore conflicts with the meaning of the verb 'join'.

Many preposition-verbs are idiomatic, as I have said; they are part of our language, but they should be used sparingly

in technology, which cannot suffer careless colloquialisms without serious loss of clarity. It may be proper to settle *down* in the country in order to settle *up* one's debts in the city. Some of these preposition-verbs are not lightly to be dispensed *with*, but the technical man should not melt *down* a charge and melt *up* a slag, nor should he test *out* a process or prove *up* an orebody. He ought to do *away with* these meaningless little obstacles to clear speech. In German such preposition-verbs are compounded, and in English it would help if we 'shut-down' a mill or 'opened-up' a mine. Usually a single and more explicit word is available. Frequently the preposition-verb is followed by a preposition, as illustrated in the examples already quoted. Here are others:

(37) "The richest mine I *met with in* my travels."

In speaking, the first preposition ('with') follows the verb ('met') without a pause, so that the second preposition ('in') is given its separate value; in reading, such a sequence of prepositions becomes ungainly or even obscuring.

(38) "The sulphides *came in on* the next level."

"Sulphides began to appear on the next level."

He was referring to the fact that the bottom of the oxidized zone had been reached.

(39) "This plan is being *carried out on* the Violet claim."

"This plan is being followed [or "This method of work is being applied"] on the Violet claim."

(40) "They are *piled on to* the thickness of six or eight inches."

"They are piled six or eight inches thick."

The 'on' is redundant, because 'piling' means the heaping of things upon one another.

(41) "The tar by-product was difficult to *dispose of to* the tar-distillers."

"It was difficult to market this tar by-product among the distillers," or "to sell this by-product to the distillers."

(42) "Three separate tests were *carried on in* this apparatus."

“Three separate tests were made [or performed] in this apparatus.”

An authority on the art of writing says:

(43) “What should we *aim at in* learning to write English?”

My reply to him is that, among other things, we should aim to avoid preposition-verbs. Each of the preposition-verbs in the foregoing five examples can be replaced to advantage by a more significant word.

The authority on writing might have said:

“What should be our aim [purpose, or object] in learning to write English?”

Here are further examples, with suggested corrections:

(44) “The ore is hard and requires to be *shaken up with* [shattered by] powder.”

(45) “The final decision was not *arrived at* [reached] *for* several hours.”

(46) “Classification was exhaustively *dealt with* [considered or discussed].”

(47) “They will not accept credits unless backed *up with* [by] a proper gold reserve.”

(48) “Nor did any one of them describe a practical form of apparatus for conducting the proposed operation *in*.”

He meant an “apparatus for performing the proposed operation.”

(49) “The investigations were not confined to ‘oils’ alone, as many substances which for the purposes of this process acted in a similar manner to oils were *experimented with*.”

“The experiments were not confined to ‘oils’ alone; they were applied to substances that acted like oil.”

(50) “The vanning-shovel shows the condition of the tin ore *which* [that] one has to *deal with*.”

Substitute ‘crush’, ‘concentrate’, ‘treat’, according to the meaning intended. “Deal with” says nothing.

(51) “This depends on whether any more can be *got out* [extracted] at a profit.”

(52) "Those who have *gone in for* [undertaken] serious work."

(53) "Oil can be *made use of* [utilized] to float mineral."

(54) "The output has been much *interfered with* [hindered or curtailed] by political disorder."

(55) "In the end the copper companies won *out*." Delete "out".

(56) "In this part of Mexico the more vitreous rhyolites are *met with*."

This suggests an encounter with a band of Yaqui Indians on the warpath. Substitute:

"In this part of Mexico, the vitreous type of rhyolite is common."

(57) "The feeding of the machine is carefully *attended to* [regulated]."

It is the result of the attention, not the act itself, that is to be emphasized.

(58) "The sinter cools *off* and disintegrates." Delete "off".

But the worst blunders arise from the misplacing of these wretched little prepositions.

(59) "These are matters which the Chamber of Mines might *with* profit devote a few minutes *to*."

"These are matters to which the Chamber of Mines might profitably devote a few minutes." This is roundabout; re-write the sentence, thus:

"These are matters that the Chamber of Mines might consider."

(60) "This is kind of you; I cannot find words to thank you *in*."

This is another example of transposition.

"I cannot find words in [or 'with'] which to thank you."

(61) "Corrosive water, which *resulted in the formation of* rust on the steel tubes and the gradual closing of the openings, was a serious obstacle."

Here we have a weak preposition-verb ('result in') and an

abstract phrase joining to obscure the sense. Probably he meant to say:

“Corrosive water was a serious obstacle, since it formed rust, which gradually closed the steel tubes.”

(62) “As an illustration of how the activities of corporations affect our daily life, I thought it would be interesting to find out how many people were employed by the corporations I would have *to deal with in* coming from New York to Denver.”

This was written by an experienced writer. He might have said:

“To illustrate how far the activities of corporations affect our daily life, I thought it would be interesting to ascertain how many people were employed by the [railroad] corporations with which I would have to deal while coming from New York to Denver.”

(63) “The properties which it now consists *of* are many old and new claims.”

He means: “The properties *of which it now consists* include many old and new claims.” However, further correction is needed, namely, the deletion of the words in italic, all of which are redundant. The plural of ‘property’ is not required. “The property now includes both old and new claims.”

(64) “The ore is broken *along* with the barren rock.”

(65) “*Over* against this pessimistic report, we have the sanguine opinion of Professor Smith.”

‘Along’ and ‘over’ are needless and awkward.

(66) “When oil is *shaken up* [agitated] with water or some [other] liquid with which it is not miscible, an emulsion is formed.” The oil, owing to its specific gravity, would rest on top of the water before agitation, which would actually result in shaking it down. ‘Shaken up’ conveys an incorrect idea.

(67) “The permission to *go on with* [continue] their business.”

(68) “I submit that the consistent way of meeting the want is for such a reserve to be *provided for in* the initial capitalization.”

The prepositions crowd each other. He means to say:

"I submit that the proper method is to provide for such a reserve when arranging the original capitalization."

(69) "This matter *has been* [was] *dealt with* [discussed] in my last chapter."

(70) "Many miles of the railway were constructed and *connected up with* the old line out of Mersina and Alexandretta." Delete 'up'.

(71) "Writing on a subject one is *interested in* is a fascinating entertainment which I have often *indulged in*."

The entertainment must have been all his, not his reader's, if he misplaced his prepositions in this way. He should have written:

"Writing on a subject that interests one is a fascinating entertainment, in which I have often indulged."

Preposition-verbs are idiomatic; for that very reason they lend themselves to misunderstanding:

(72) "How did you *come to* fall into the pond?" said the farmer to the dripping lad, still clutching his fishing-rod. "I didn't; I came to fish", he sobbingly replied.

(73) A soldier running to the rear is asked: "What are you *running for*?" He retorts: "You should say, 'What are you *running from*'?"

A typical example is:

(74) "The richest mine I met *with in* my travels." Apart from the awkwardness of coupling two prepositions that are not related to each other, this quotation exemplifies the use of a preposition-verb that itself has no significance and serves only to set aside the verb that tells the meaning, namely, whether the writer 'visited', 'inspected', or 'saw' the mine, or whether he merely heard about it from others in the course of his travels. 'Met with' is one of those old colloquial idiomatic phrases that say nothing. Similar criticism applies to many other preposition-verbs; they are wholly unsuited for use in technical writing, which aims to convey crystallized ideas and precise information.

The preposition has many uses, and they are made more

significant by avoiding misuse. Here are some examples of good usage.

(75) "The oil and water (as an emulsion) is fed *in* at the centre and thrown *out* at the circumference."

Here "in" and "out" are antithetic. The singular verb is correct because the "oil" and the "water" are considered as a unit.

(76) "The flask containing the extract was placed on a water-bath; after most of the ether had been distilled *off*, the residue was transferred to a small separating-funnel of known weight." Here the "off" is emphatic.

The preposition-verb is idiomatic; so also sometimes is the placing of the preposition at the end of the sentence; our language derives these idioms from the Anglo-Saxon, or Low German, part of its origin. In German one says:

(77) "Machen Sie die Thüre *zu*."

Old-fashioned provincial people in the West of England still say: "Shut the door *to*."

(78) A Cornish miner will say: "Where be going *to*?"

The gain of emphasis by placing a preposition at the end of a statement survives, usefully, in such a phrase as: "Just now Russia is a good country to come *from*." This was written by an engineer who had arrived in San Francisco from a copper mine in Siberia; the statement is not only idiomatic but highly expressive, for the three significant words are 'now', 'Russia', and 'from'; of these the last is the most significant; it gains significance by being last.

In such sentences the preposition has an adverbial value; as also in

(79) "He has gone *out*."

(80) "He told him to sit *up*."

In the first lecture I quoted Huxley. You will remember what he said of a writer who used big words needlessly: "He will be afraid to wander beyond the limits of the technical phraseology *which* he has got *up*." Here "up" is adverbial. It ends the sentence unpleasantly. "Got up" could be replaced

TECHNICAL WRITING

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by which by an improvement to substitute 'that' for 'which',
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IX. HYPHENS AND COMPOUND WORDS.

A severely technical article, however well written, cannot be an agreeable form of literature. It suffers from the defects of its qualities. One defect is a congestion of language, due to a multiplicity of adjectival nouns. The sentences are packed with words of unpleasing sound, charged with complex ideas, crowding one another so closely that the phraseology moves like an ice-pack in Bering Sea or a log-drive in a river; the undercurrent of meaning may move confidently, but the surface is obstructed.

To regulate the flow of language, so as to indicate the relation of adjoining words, it becomes necessary to use hyphens. Hyphens are unlovely assistants, regrettable necessities, but without them the writer of technology must fail to convey his thought, or must seek a mode of expression so roundabout as to exhaust the reasonable limits of time and paper. For example:

(1) "High speed tool steel is much in demand by manufacturers of munitions."

The sense of the first four words, one an adjective and the others nouns, is not obvious to the uninitiated; the meaning is that there is a demand for a steel suitable for making tools that serve as cutting instruments when run at high speed (in such machines as lathes, planes, and drill-presses). This is said, and said clearly, by inserting two hyphens thus:

"High-speed tool-steel is in much demand by manufacturers of munitions."

The use of hyphens is not generally understood by engineers; either they do not employ them sufficiently to make themselves clear, or they sprinkle them like the sand that an earlier generation used, for drying the ink, before blotting-paper had been invented.

Consider the difference between

cooling floor	and	cooling-floor
sinking pump	“	sinking-pump
level floor	“	level-floor
iron furnace	“	iron-furnace
paper mill	“	paper-mill
zinc box	“	zinc-box
sample bottle	“	sample-bottle
tin plate	“	tin-plate
bent rod	“	bent-rod
melting point	“	melting-point
burning oil	“	burning-oil

A ‘cooling floor’ is one that is growing cold; a ‘cooling-floor’ is one on which hot ore is cooled; it is a floor *for* cooling. A ‘sinking pump’ is a pump that is sinking or subsiding; a ‘sinking-pump’ is a pump to be used in sinking a shaft; it is a pump *for* sinking. A ‘level floor’ is one with a uniformly horizontal surface; a ‘level-floor’ is the floor of a level in a mine. A ‘paper mill’ is one made of paper; a ‘paper-mill’ is one that makes paper. An ‘iron furnace’ is a furnace made of iron; an ‘iron-furnace’ is one used for smelting iron ore. A ‘zinc box’ is made of zinc; a ‘zinc-box’ contains zinc, as, for example, the box in which zinc is placed to precipitate gold from cyanide solutions. A ‘sample bottle’ is a sample of bottles; a ‘sample-bottle’ is a bottle to hold a sample. A ‘tin plate’ is a plate of tin; ‘tin-plate’ is iron that is plated or covered with tin. A ‘bent rod’ is a rod that is bent, but a ‘bent-rod’ is a detail of a conventional engineering structure. A ‘melting point’ is a point that is melting; a ‘melting-point’ is the point at which melting begins. A ‘burning oil’ is oil that is burning; a ‘burning-oil’ is an oil suitable for burning. The ‘solid surface’ is the surface of a body that is not solid underneath, whereas the ‘solid-surface’ is the surface of a solid, and it is as well to say so, by aid of the hyphen, instead of indulging in round-about explanations.

A 'single stamp-mill' is a lonesome mill.

A 'single-stamp mill' is a mill consisting of batteries of one stamp each, like the Nissen, instead of the usual five stamps per battery.

A 'single-stamp-mill' is a mill containing only one stamp, after the Lake Superior fashion, where one big steam-stamp does the work of 150 ordinary gravity-stamps.

A 'crude ore-bin' is an ore-bin of crude construction.

A 'crude-ore bin' is a bin made to contain crude ore, that is, ore as it comes from the mine, before it has been crushed, concentrated, or subjected to other preliminary treatment.

A 'crude ore bin' is an example of crude writing.

Hyphens are not agreeable things, as I have said, but they are a great help in technical writing. For instance:

(2) "The crushed section of No. 2 shaft had to be entirely recovered and retimbered."

What does he mean? The shaft has been timbered again or 're-timbered', that is clear; but has the shaft collapsed and has it been 'recovered', that is, restored, or has only the covering of the shaft been shattered, so that the shaft has had to be 're-covered'? If he had used the hyphen in 'retimbered', it would have made clear his whole statement by giving significance to the omission of the hyphen in 'recovered', but as he omitted the hyphen in the one place, where it was wanted, he may have omitted it in the other also, so that one can not determine whether the shaft has been 'recovered' or 're-covered'. The difference is important, as measured in money and time.

The following are wrong:

(3) Air transmission-pipe.

(4) Dry vacuum-pump.

(5) Tungsten filament-lamp.

(6) The standard Merrill screw zinc-dust feeder.

(7) Stock solution-tank.

(8) Compressed air-motors.

(3) It is a pipe for transmitting air, not an airy pipe of transmission; therefore the hyphen should be transferred thus:

Air-transmission pipe.

(4) The emphasis is on the dry vacuum, not on the dryness of the pump. It should be

Dry-vacuum pump.

(5) The filament is made of tungsten, not the lamp. Hence Tungsten-filament lamp.

(6) The word 'screw' modifies 'feeder'; he meant

The standard Merrill zinc-dust screw-feeder.

(7) The solution was kept in stock, not the tank; he meant the tank in which the stock solution was kept, thus:

Stock-solution tank.

(8) The air is compressed, not the motor. It should be

Compressed-air motor.

Out of a single article I take the following examples of compound words. I shall give them to you first without the hyphens and you will note what a jumble of meanings they suggest. Then I shall insert the necessary hyphens and you will see how the thought emerges:

(9) Crushing plant conveyor belt.

Crushing-plant belt-conveyor.

The traveling belt that conveys the ore to the plant where it is crushed.

(10) Electric bell overhead alarms.

Electric-bell overhead-alarms.

Alarms were placed overhead, and these alarms consisted of bells operated electrically.

(11) Ball check air inlet valves.

Ball-check air-inlet valves.

They are valves that check the admission of air by means of balls acting automatically.

(12) A screw conveyor chain driven from the classifier shaft.

A screw-conveyor chain-driven from the classifier-shaft.

This is a screw the turning of which moves the pulp, conveying it to another part of the mill. The screw is turned by means of a chain that is driven from the shaft that also drives the classifying machine.

(13) "The motor is connected to the tube mill gear shaft by silent chain drives and Hill clutches."

"The motor is connected to the tube-mill gear-shaft by silent-chain drives and Hill clutches."

This motor furnishes the power that causes the tube-mill to revolve, such power being transmitted to the cogs on the perimeter of the tube by means of a noiseless chain, the sprocket-wheel of which is engaged and disengaged by a Hill clutch.

Other examples follow:

(14) "The blast furnace gas will be delivered to a bag house through 600 ft. of brick dust chamber."

Note how a few hyphens, properly placed, clarify the sentence:

"The blast-furnace gas will be delivered to a bag-house through 600 ft. of brick dust-chamber."

The chamber is not made of brick-dust.

(15) "These cannel coal tar oils are high in paraffine."

No clear idea emerges until a couple of hyphens are placed in their right places:

"The cannel-coal tar-oils are high in paraffine."

(16) "From this base line right angled lines were extended in the direction of the dip of the vein."

The sentence should be written: "From this base-line right-angled lines were extended on the dip of the vein."

(17) "The best compound condensing poppet valve steam engine will produce an indicated horse-power hour on 12 pounds of steam."

When I read the last example I was reminded of the lady in Kansas after the tornado had passed. It is related that "she looked up from her washing and found the air thick with her intimate friends." The broken limbs of this sentence must be joined with grammatical splints, these useful hyphens of which we are speaking, thus:

"The best compound-condensing poppet-valve steam-engine will produce one indicated horse-power per hour on 12 pounds of steam."

(18) "As to the dressing of the amalgamated plates, he concluded that 12 hour intervals were the best."

Was it 12 intervals of one hour or was it intervals of 12 hours each? He meant 12-hour intervals.

(19) Similarly: "A train of ten ton cars" leaves it questionable whether it be "a train of ten 1-ton cars" or "a train of 10-ton cars."

(20) "Each of the two hundred foot sections." Is it "each of the 200-ft. sections" or "each of the two 100-ft. sections"?

Compound adjectives preceding the noun that they qualify require hyphens, as "first-class ore", "3-inch pipe", "five-mile haul". This applies to compounds with 'well' and 'ill', like a "well-established industry" or "an ill-advised action", but hyphens are not desirable after longer adverbs modifying adjectives, as in "hastily written report" or "nearly completed work".

Hyphens are of great service in technology, however ugly they may seem to the litterateur, to the writer of polite prose. No engineer can afford to ignore them if he desire to write clearly.

(21) "The average shoe-and-die consumption in a stamp-battery".

The wear of shoes and dies concurrently is the subject.

(22) "An early design of central-discharge ball-tube mill".

The two hyphenated words modify "mill". This would not be expressed by "central discharge ball tube-mill". It is a mill of tubular shape in which steel balls are used to expedite grinding, the pulp being discharged through a central opening. 'Ball' and 'tube' modify 'mill' equally.

(23) "His theory is what one might term a *resolution* theory." As if he were a man of high resolve. It should be 're-solution', referring to the secondary dissolving of the gold.

Note similarly the difference between 'retreat' and 're-treat':

(24) "Mining was started at the edge of the ore on the top sub-level and carried downward level by level: this *retreating* method was desirable for two reasons."

He says what he means, the hyphen is not needed; but it is necessary in the following statement:

(25) "The method of *re-treating* the tailing was introduced by a clever metallurgist named Smith."

Note how much clearer the meaning is conveyed by 'half-way' than by 'halfway'.

Now you have seen how important a function is served by the hyphen. No cast-iron rule can be formulated to guide you in this matter, but I may say to you that a varying degree of intimacy exists between words. Three degrees of intimacy are to be noted:

A. Mere juxtaposition, or neighborliness, of separate words, indicating a loose connection.

B. Hyphenation, implying intimacy without an entire loss of individuality.

C. Compounds, expressing a singleness of meaning.

Roughly the three states in which two adjacent words may exist can be represented by single blessedness, betrothal, marriage. The hyphenated condition, like an engagement, may be broken, and a word may form a new combination with another word for which it has affinity. After a time, two words may have been hyphenated so long that they acquire a singleness of meaning, they are married, and are treated as a unit. For example, 'today', 'tonight', and 'tomorrow' require no hyphens. The retention of them is due to unthinking conservatism. The 'to' in 'today' has no significance apart from 'day'. The word expresses a single idea and the hyphen is a meaningless survival. It has been estimated that 150,000,000 persons write these three words, 'to-day', 'to-night', and 'tomorrow', three times daily, on average, and that the omission of the hyphen would save an amount of energy in the aggregate equal to that required to propel an ordinary passenger-train round the world. Let us save the energy thus squandered and use it in placing our hyphens where they are needed.

In hyphenated terms like 'cooling-tower' and 'precipitating-tank' the first member of the couple is a gerund; it is a verbal

noun identical in form with the present participle; but the participle is an adjective, and the gerund is a noun that has the power to govern another noun. In these and similar common hyphenated terms (for example, 'amalgamating-tables', 'condensing-chamber', 'leaching-vat') the preposition 'for' must be understood; we mean 'a tower *for* cooling gases', 'a tank *for* precipitating solutions', and so forth. If the phrase have this meaning, the hyphen should be inserted; if not, it should be omitted. A 'precipitating solution' is one that is in the act of precipitating; if the reference is to a solution *for* precipitating something else, the hyphen would indicate this meaning, thus, a 'precipitating-solution'. A 'frothing-agent' is an agent *for* making froth, not one that froths.

In technical writing it is necessary to compound words in order to condense the phrasing, and the hyphen is a means of doing so, but the careful writer will avoid throwing words together in a telegraphic style that leaves the sense obscure. Aristotle said that the use of compound words, "such as Lycophron's 'many-visaged heaven', 'vast-crested earth', and 'narrow-passaged strand'" was in bad taste. He remarked also that they were "eminently serviceable to dithyrambic poets, whose style is noisy". The moral is to avoid careless compounding and to indicate careful compounding by hyphenation.

(26) "Too much air increases the *fuel consumption* [consumption of fuel]."

(27) "The Bureau of Mines made a study of *fume losses* [losses in fume]."

(28) "This is done to prevent *edge wear* [wear at the edges]."

(29) "The *rubber belt* manufacturers [of rubber belts] have shown great interest in this subject."

(30) "Except where a gulch marks a *stream-course* [the course of a stream]."

(31) "The assay is given a *borax glass cover*."

A hyphen between borax and glass would help to clarify

the description, but it is better to avoid the adjectival use of 'borax-glass' by saying "a cover of borax-glass".

(32) "The *appraisal system* is technically an admirable one."

"The system of appraisal is admirable technically."

(33) "A *water spray* cooled the air."

It was the water, not the spray, that cooled the air; therefore it is better to say:

"A spray of water cooled the air."

(34) "The *air and power consumption* was not determined."

"The consumption of air and of power were not determined."

(35) "A typical copper flotation tailing screen and copper analysis follows which illustrates this point."

What a jumble! He means:

"A screen analysis, with assays, of the flotation tailing from a typical copper ore will illustrate this point."

In each of the foregoing quotations it is possible to use a hyphen to mark the relation of the compounds, but it is not desirable, the meaning being made clearer by straightforward writing involving the use of a preposition to indicate the relation between the words.

(36) "Heavy metal salts".

He means 'heavy-metal salts', but it is better to write "salts of the heavy metals".

(37) "Chlorite is present as a persistent alteration product from biotite."

Is it a product of persistent alteration or a persistent product of alteration?

(38) "The machine that weighs the mixed ore and concentrates charge."

Here the four words before 'charge' constitute an adjectival clause; the meaning is held in suspense too long, and the effect is confusing. He means:

"The machine that weighs the charge of ore and concentrate." The charge is obviously a mixture.

(39) "Allow a full *air draught* [draught of air] to pass through."

(40) "Specially designed cars".

"Cars of special design".

The adjectival use of nouns and the consequent coupling of nouns is carried to an excess that is disagreeable. Often it clouds the expression or entails unnecessary hyphenation.

(41) "*Mine sampling* is never an easy task."

"The sampling of mines is never an easy task."

(42) "The *vein course* was indicated by a mere seam."

"The course of the vein was indicated by a mere seam."

Hyphens are required between the two words italicized in each of the two sentences last quoted. They can be avoided by the alternative phrasing.

(43) "The *air volume* [volume of air] is calculated from its velocity in a drift."

(44) "This greatly reduced the *gas consumption* [consumption of gas]."

(45) "There are no *cost figures* [figures of cost] as yet."

(46) "A battery charging and changing station."

"A station for charging and changing batteries."

(47) "An additional 10% of the sulphur is allowed as *furnace oxidation loss* [for loss by oxidation in the furnace]."

(48) "This is true of powdered coal fired reverberatories."

"This applies to reverberatories (or reverberatory furnaces) fired with powdered coal."

In this last example, as quoted, the three words preceding 'reverberatories' constitute an adjectival clause. Such tumbling of words together has become an ugly characteristic of technical writing; it avoids hyphenation, it is true, but only at the cost of a worse construction, if anything so unsystematic and inarticulate can be thus dignified. More than any other defect, this habit renders technical writing not only non-literary but uncouth. So, take pains to avoid it, either by using the necessary prepositions or by an intelligent use of hyphens.

The 'fifty-first' means the one coming after fifty, but the 'fifty first' are the fifty that come first, the first fifty.

(49) "Light house-keeping is not good for light-house keepers."

Finally, consider the difference, the pathetic difference, between 're-covering' an old umbrella that is out of repair, and 'recovering' a new umbrella, perhaps a Christmas gift, that you had lost.

X. SLOVENLINESS

Slovenliness is as disgraceful in words as in clothes. Much writing that we recognize as poor in style is merely sloppy. Just as some students postpone the necessary shave or forget to change their collars, so young engineers drop their articles, definite and indefinite, or omit prepositions where they are required, as if to compensate for those they use unnecessarily.

(1) "[During] the preceding summer I went to Nevada."

(2) "The work will begin [on] Saturday."

(3) "Influenza seriously affected many mines [during] the last three months."

(4) "Flotation in America [during] the last two years has made tremendous strides."

The sign of the infinitive should not be omitted; this is a common blunder.

(5) "All such work helps [to] solve the problem of efficiency."

The verb *be* is used both as a principal and as an auxiliary.

(6) "At first the work was interesting and [was] liked by most of the men."

(7) "The drop of *crusher lubricating oil* could not get into the bin and mix with the ore."

The adjectival use of nouns leads to a jumble; he means

"The lubricating oil on the crusher could not drip into the bin and mix with the ore."

(8) "Construction of the mill started [on] August 12, 1915, at which time 75% [three-fourths] of the excavation was completed."

Abridgements that leave the reader to guess the writer's meaning are bad. Theodore Roosevelt wrote:

(9) "While camped on the Nzoi, the honey-birds were almost a nuisance."

Roosevelt and his party, not the honey-birds, were camped on the Nzoi. Such elliptical phraseology is slovenly.

Do not omit the connecting pronoun.

(10) "Their vein is not as wide, nor the ore as rich, as the Combination."

"The vein in their mine is not as wide, nor the ore as rich, as that in the Combination."

(11) "Many mining booms such as [those of] 1906 and 1916."

(12) "A rate of drilling much superior to [that of] the old piston-drill."

A finite verb must agree with its subject, says the rule.

(13) "One of the most brilliant contributions to geology that *has* [have] been made."

The correct form sounds awkward; the attractive form is wrong; avoid both. The clause "that has been made" is redundant.

(14) "Anyone can measure with a glance, when *they* are tired."

Ruskin, who wrote this, meant 'when he is tired' or 'when tired'.

Participles are commonly misused by novices. The dangling of a participle at the beginning of a sentence contravenes the rule of grammar that the substantive to which a participle relates must appear in the same sentence. For example:

(15) "Approaching the vein, the serpentine is seen to be decayed."

"As we approached the vein, we observed that the serpentine was decayed."

(16) "Examined carefully no fossils were detected."

"Although I examined the rocks carefully, I could detect no fossils" or "Although the rocks were examined carefully, no fossils were detected".

(17) "Turning westward there is a striking change."

"Turning westward the observer beholds a striking change."

(18) "In going seaward the boulders become smaller."

"Toward the sea the boulders are smaller."

Even practised writers are frequently guilty of the error of using participial phrases having no logical relation to the clauses preceding. Thus:

(19) "The sandstones are massive, occurring chiefly in the lower half of the formation."

"The sandstones, which are massive, are chiefly in the lower half of the formation."

(20) "The output of the mine is about 100 tons daily, its assay-value being \$50."

"The daily output of the mine consists of 100 tons of ore, averaging \$50 per ton."

Another misuse is illustrated in the sentence:

(21) "The vein has a general width of 1 to 6 inches, *widening* [but] in places [it widens] to 12 inches."

Here the participle is used as an adversative, or contradicting, term.

(22) "The limestone *occurs resting* [rests] upon the quartzite."

(23) "These dikes *were found cutting* [cut] the granite."

(24) "The cliff *rises facing* [faces] the river."

The choice of the wrong subject-nominative leads to wordiness:

(25) "*The drainage of the area is accomplished* [drained] by three streams."

(26) "*The collection of the statistics is done* [are collected] by correspondence."

Delete the first three words in each of the two foregoing sentences.

(27) "*Confirmation of these reports cannot be obtained* [confirmed]."

As says George M. Wood,* from whom the three preceding examples are borrowed:

"The writers of these sentences, having 'used up their verbs' in their subject-nominative, could find no suitable

* 'Suggestions to Authors' by George McLane Wood. U. S. Geological Survey. An extremely useful pamphlet.

predicate-verbs and were compelled to employ instead more auxiliaries or inappropriate words."

The use of 'due' at the beginning of a sentence in the sense of 'attributable' is a common error, for the reason that a causal phrase, which is adverbial, should not be introduced by an adjective.

(28) "*Due* [owing] to the *psychological* attitude of *labor* [Labor] and the scarcity of skilled operatives, it is far more difficult than ever before to secure high efficiency." Delete "psychological", which is redundant.

(29) "Such problems are nearer solution, *due* [thanks] to the researches of Bragg and others."

(30) "This is explained by the fact that this substance, *due to* [in consequence of] the predominating effect of the calcium, coagulates the slime."

(31) "*Due to* the nature of the ore, it is expected to obtain a smelting ratio of seven of ore to one of coal."

Here 'due to' stands for 'in consequence of' or 'owing to'.
Again:

(32) "*Due to* the rise in copper, many mines are being re-opened in this district."

Those who fall into this bad habit are also likely to begin their statements thus:

(33) "*Indicative of* the success of the method is the cost which is now 60 cents per ton."

This can be improved:

"The success of the method is indicated by the low cost, which is now only 60 cents per ton."

'Tend' is a word that prolongs a sentence without adding to the sense. Many writers enfeeble a verb by inserting the superfluous 'tend'.

(34) "The use of flotation *tends to aid* [aids] the saving of copper in chalcocite ores."

(35) "Such methods *tend to cheapen* [cheapen] the operation."

Unemphatic words at the beginning of a sentence usually precede roundabout statements:

(36) "*Because* the surface tends to contract with a definite force does not mean that it is coated with anything like a rubber membrane."

It would be better to write:

"The fact that the surface contracts with a definite force does not prove that it is coated with anything like a rubber membrane" or "The contraction of the surface does not mean that it is coated, etc."

Here is another example of a poor beginning:

(37) "*By* such a system I believe we could establish a foreign trade based on honesty of goods *which* other nations would find it hard to take from us."

Here "by" is a weak introductive. He means:

"Such a system, I believe, would serve to establish a foreign trade so well based on honesty of goods that other nations would find it hard to compete with us."

'While' is another little word much misused. Instead of being restricted to its primary function as an adverb of time, it is employed as a conjunction synonymous with 'whereas', 'though', 'but', or 'and'.

(38) "*While* [whereas or although] coal and iron command high prices, oil has become cheaper."

(39) "At some points the ore is 4 feet wide *while* at others it narrows to 6 inches."

Insert a semicolon after "wide" and delete "while".

'Along these lines' and 'along this line' is a common crudity. It is neither precise nor clear.

(40) "Examinations *along these lines* were made every year."

"Examinations of this kind (or for this purpose) were made every year." Perhaps "similar examinations" would express the meaning, which is still left in doubt.

(41) "The development of the mine *along this line* is sure to prove successful."

"The development of the mine in accordance with this plan is sure to prove successful."

(42) "Investigations *along* petrographic *lines* are not needed."

"Petrographic investigations are not needed."

'Occur' and 'occurrence' are over-worked, especially by geologists. They are words to be used sparingly.

(43) "The other *mineralogical occurrence* [mineral] I found in the Gila Canyon Consolidated Copper Co.'s mine."

(44) "There are seldom any signs of secondary copper enrichment, unless it be the occasional *occurrence* along cracks of pyrite."

He means: "Signs of sulphide enrichment are rare, except where the pyrite has been deposited along cracks." "Occasional occurrence" suggests time; he means place; here and there the pyrite was detected by him along the cracks. "Cracks of pyrite" is a bad phrase.

(45) "The gold *occurs* [is] distributed over a large area."

(46) "The fluor spar mines *occur* [are] in Pope and Hardin Counties."

Usually 'occur' takes the place of a word that is more specific.

(47) "Hardwood trees *occur* on these slopes."

The word he needed was 'grow'.

(48) "In parts of the mine where the fault *occurs*, the veins are shattered and impoverished."

He means that where the veins are crossed by the fault, they are shattered and poor in gold.

(49) "The telluride *occurs in* [lines or encrusts] *the interior of the cavity.*"

A 'cavity' is a void, considered with reference to the circumjacent material. "The telluride encrusts the cavity."

(50) "Underlying this decomposed garnet in the formerly barren crystalline lime [are] the secondary zinc ores *occur.*"

Delete 'occur' and end the sentence with a significant word.

Writers who overwork 'occur' are likely to introduce their statements with 'there is' and 'there are', both of which are poor locutions—the mere tuning of language.

(51) "Wherever the galena occurs *there is* an increase of silver in the ore." The man that wrote this failed to say where or how the galena was distributed in the lode or vein, and thus omitted a necessary item of information.

"Wherever the galena is seen, there the ore is richer in silver.

(52) "Small packages can be easily carried and *there is* not the incentive to drop them by the carriers." This can be amended thus:

"Small packages can be carried easily, therefore the carriers are not tempted to drop them."

(53) "*There are* few Cornishmen employed at Treadwell."

(54) "I question whether *there is* any probability of succeeding with this process."

These statements may be improved thus:

"Few Cornishmen are employed at Treadwell."

"I question whether the process can succeed."

(55) "*There are* more men killed in metal-mining in the United States, in proportion to the number employed, than in the country's coal mines."

Here 'there are' merely detracts from the force of the statement; start with "More men are killed" and note how much more direct and forceful it is.

'It is' belongs in the category of feeble introductions.

(56) "*It is the belief of* the miners that the ground now worked may be a slide."

"The miners believe that the ground etc."

(57) "*It is* a sign of richness in gold when the quartz is ribboned."

"The ribboning of the quartz indicates richness in gold."

Begin and end a sentence with an emphatic word, as far as may be practicable without stiling the phraseology.

Avoid redundancy. In the following examples the italicized words should be deleted:

(58) "The railway should be finished in nine months *time.*"

(59) "It requires several weeks or months *time* to treat the ore."

(60) "The mine is three miles *distant* from the mill."

(61) "Timbers are set *at a distance of* 4 ft. 2 in. centre to centre."

(62) "The peak is 12,750 ft. *high* above sea-level."

(63) "Manganese *if present* can be precipitated at the same time as the iron."

It must be present in order to be precipitated.

(64) "It is best to use zinc sheets 2 feet by 3 feet *in size*." ✓

Do not attempt to be impressive by piling one word on another.

(65) "Records were started with this *ultimate* end in view."

(66) "He cannot return home before the *final* completion of the mill."

(67) "This oil will serve *equally* as well as oleic acid."

(68) "The roasting will require *probably* about seven hours *time*."

Study the meaning of words so that you will not employ 'evince' or 'evidence' when you mean 'show'; 'phenomenal' when you mean 'extraordinary'; 'transpire' for 'become known'; or 'problematical' for 'doubtful'. As you obtain literary taste, you will abhor 'advent' as a synonym for 'introduction' or 'arrival'; 'situation' for 'state'; 'eliminate' for 'extract'; 'avoid' for 'destroy'; 'proposition' for 'proposal'; 'contemplate' for 'plan' or 'intend'; 'balance' for 'compensate'; and 'unethical' for 'improper'.

(69) "The stamp-mill held its own until the *advent* [introduction] of the cyanide process."

(70) "The treatment of the pyritic copper ores awaited the *advent* [application] of modern smelting methods."

(71) "The *cyanide situation* [scarcity of cyanide] in Northern Ontario."

(72) "A tramway will be built around Mineral lake to *eliminate* [avoid] the use of barges."

(73) "The *proposition* [proposal] made by the union was rejected."

(74) "The erection of one smelter and the completion of others now *contemplated* [planned or proposed]."

(75) "It would be *unethical* [improper] to disclose my reason for withdrawing from the case."

(76) "The natural expectation would be that *they* [each] (Carranza and Villa) *will each* [would] *start in to eliminate* [destroy] the other."

No man with a right feeling for language would be guilty of such lapses. Acquire good taste by reading good literature: Huxley and Spencer, Thoreau and Lowell. Read 'The Atlantic Monthly', 'The Outlook', and 'The World's Work', not the magazines that adopt the language of the street.

If you read only second-rate stuff, you will lose the taste for good English, and the quality of your own writing will suffer, until you may even be guilty of such lapses as the following:

(77) "There are companies arranging to install commercial size units of several new inventions. It is far from probable that all these schemes will prove successful and therefore one anticipates hearing of disappointments experienced by the pioneers in this work."

He may have meant to say:

"Several companies are arranging to erect working units based upon new inventions. It is unlikely that all these schemes will prove successful, and one may anticipate that the pioneers will suffer many disappointments."

(78) "In practically every instance, operators plan to make the fuel item a self-contained proposition."

He is speaking of oil-shale, and he means:

"Most of the operators plan to use the shale itself for fuel."

(79) "These often contain cassiterite, sometimes in profitable quantities, but long before the water sorted gravels are reached the wolfram has disappeared, though it comes from the same lodes as the tin ore where it almost invariably occurs in considerably greater quantities."

Probably he meant:

"In many localities these alluvial deposits contain sufficient cassiterite to be mined profitably, but long before the water-sorted gravel is reached the wolfram has ceased to appear, although it is derived from the tin-bearing lodes, in which it is invariably the predominant mineral."

That may not have been his meaning; the worst of such writing is not its ungainliness but its obscurity. It may not be intended to be beautiful, but it certainly is intended to convey information, and in that it fails.

(80) "In a cross-cut on the 14th level in ground to the east of the main drift along the line of the larger ore shoot a vein of quartz was struck, which on being followed soon developed values, and further on extraordinary values."

Would you think of engaging the services of an engineer showing so little intelligence? He may have meant to say:

"On the 14th level a cross-cut going eastward from the main drift, that is, the one along the line of the larger ore-shoot, struck a vein of quartz, which, on being followed, began to show ore and a little farther yielded ore of extraordinary richness."

(81) "There has never been any doubt that the problem of dry concentration would some day be solved and its present successful *advent* should not be passed by without at least an investigation."

Was it the "advent" or the "problem" that merited attention? How does one 'pass by' an 'advent' even in the dark?

"It never was doubted that dry concentration would some day prove successful, therefore this latest experiment is well worthy of attention."

Use words so that each one may be significant. We keep different tools for different kinds of work, thereby gaining efficiency. Keep each word to its allotted task. Do not dull the edge of a chisel by using it as a screw-driver.

'Differentiate' refers to a physical process of becoming different; it is not a correct synonym for 'discriminate' or 'distinguish'.

(82) "It would not be fair to *differentiate* [discriminate] against him."

'Designate' is to specify or particularize, not to choose, appoint, or name.

(83) "He *designated* [appointed] Jones foreman."

'Visualize' is to make visible, to imagine vividly, not to see, describe, or illustrate.

(84) "He was unable to *visualize* [imagine] the horrors of War."

'Discount' is to deduct from an amount or make allowance, not to expect, anticipate, or offset.

(85) "The manager *discounted* [anticipated] the caving of the stope."

These examples should serve as warnings to the engineer, who nowadays makes a fetish of efficiency, and writes articles upon it in ineffective language.

An American provincialism that is gaining ground is the use of a geographic noun as an adjective, thus:

(86) "A *California* [Californian] mining engineer".

(87) "The *Alaska* [Alaskan] method of drift mining."

Our daily papers show such head-lines as 'Good Italy Harvest'; 'Great Albania battle'; 'U. S. Victory'. In these the corresponding adjective is desirable: Italian, Albanian, American. Undoubtedly such newspaper usage is corrupting; technical writers should take care not to copy the habits of the illiterate.

Careless writers, with a fondness alike for the abstract word and the unnecessary plural, also show a preference for vague terms when precise ones are available. They use the present participial of a verb in place of the noun itself; thus

capping	instead of	cap
cropping	"	outcrop
filling	"	fill
faulting	"	fault
heavy stulling	"	big stulls

(88) "A *capping* [cap] of leached monzonite covers the ore."

(89) "There *are* [is] no *croppings* [outcrop] of the vein to guide the prospector."

(90) "The *fillings* [fill] in the old stopes can be milled at a profit."

Abstraction is carried to inanity by scribblers who change

nations	into	nationalities
authors	"	authorities
events	"	eventualities.
persons	"	personalities
characters	"	characteristics

It is well to look askance at words ending in 'ism', 'istic', and 'ization', for they come of a vacuous tribe.*

Technology knows no political boundaries. The part of it written in English goes around the world. We exchange freely with the British and their cousins overseas. The English language is the common heritage alike of the American and the Briton, both of whom befoul it with vulgarisms and colloquialisms that are understood only locally or regionally. In order that technical literature may pass current wherever our language is spoken, and even in foreign countries where it has to be translated laboriously, it is our duty to discard local terms or provincial phraseology. For example, 'reef' as used for 'lode' in Australia and 'ledge' as used for 'vein' in California are both objectionable terms. An orebody underground has no resemblance to the rock that imperils navigation, nor does a vertical outcrop resemble a shelf.†

The Australian puts his 'mullock' [waste rock] in a 'paddock' [enclosure] while the American puts his 'dirt' [ore] in a steel 'tank' [bin]. The 'mullocker' at Bendigo is equivalent to the 'mucker' at Tonopah, and each is a 'shoveler' in good English. I need not multiply examples of bucolic terms and illiterate

* Allbutt. Op. cit. Page 144.

† A 'ledge' of oil-shale is correct, because the shale is nearly horizontal and projects from the face of a hill like a shelf.

localisms. They disfigure technology and obstruct scientific thought. Why should a scientific man—for that assuredly describes the mining engineer—go to the illiterate workman for his terms? If you wish to learn how to break rock ask the Cornish or the Italian miner, by all means, but if you wish to use the delicate instrument of expression accurately ask those who are trained in the art. As graduates of a university you are expected to obtain your terminology from the library, not from the stope; you should shape your phraseology on that of the college, not on that of the bunk-house.

(91) "These *tanks* [steel bins] have proved satisfactory, especially to the mill-men, who are relieved of all ore-bin *mucking*."

He means that they are relieved of the labor of shoveling inside the ore-bin.

Such adoption of local vulgarisms by careless writers may be defended by shallow critics as one phase of that absorption of new elements by which a language grows. Of course, the English language is a living organism fed continually out of the varied human experience of our peoples—the American and British predominantly, but also the others who speak it across the seven seas. All of which in no wise excuses a literate engineer in displacing recognized technical terms by half-baked provincialisms.

To write well you need self-restraint—a grip on yourself. The notion prevails in some quarters that it is effeminate to use words with nicety, that the practical man is expected to fling them about him with careless vigor. That is a mistake. An educated man is disciplined in words as in conduct. Indeed, the self-discipline of writing is a splendid training for any engineer. It teaches him how little he knows accurately, and spurs him to gain a more thorough understanding. The turbid pulp in a mill is made clear by passing through classifiers and settlers, so that the metal is precipitated in a pure and crystalline form. Similarly ideas, odds and ends of information, stray bits of observation, if passed through the mind in the act of writing

are co-ordinated, classified, and systematized into workable shape, into definite form, ready for immediate use.

In technology we should try to keep each term for a specific duty.

'Locate' and 'location' should be restricted to the delimiting of a claim. If we use these words in other senses, we cause confusion.

(92) "He *located* the mill on Deer creek."

Did he 'locate' a mill-site or did he build a mill on the creek?

(93) "The superintendent *located* [found] the ore-shoot on the fifth level."

(94) "He is now *located* at Silverton."

"He lives at Silverton now."

(95) "The mine is *located* in Northern Rhodesia."

Delete 'located', or substitute 'situated'.

'Carboniferous' and 'carbonaceous' have different meanings. They should not be used interchangeably. 'Carboniferous' referred originally to the geologic division of time associated with the formation of coal, but all Carboniferous strata do not contain coal. It is now simply the name of a geologic period, and is given a capital 'C'. 'Carbonaceous' means carbon-bearing, or containing carbon; it may be used to describe a black shale. A rock may be both Carboniferous and carbonaceous, as in Missouri, where a limestone belonging to the period immediately succeeding the Devonian is black with the product of decomposed vegetal [not 'vegetable'] remains.

'Calcining' and 'roasting' are not synonyms. The first should be applied to a process for removing carbon di-oxide from carbonates, such as limestone, or for dehydrating a hematite ore; the second should be restricted to a process for the expulsion of sulphur by heat in the presence of oxygen.

'Tank' is a term sadly over-worked. It means a large vessel used for storing liquid. A large vessel employed for conducting a chemical process may better be called a 'vat'. This distinction is not often observed, but it can be made to advan-

tage in technical writing. Recently the word 'tank' has been used for a cylindrical steel ore-bin. This use only serves to confuse. An engine of war lately devised has been called a 'tank', although it is more like a glyptodon or some other monster of the primeval slime. We can forgive the 'boys' in the trenches anything, but not the metallurgist that calls an ore-bin a 'tank,' as if in mockery of these dry days.

A 'chute' is a sloping channel down which material is passed; a 'shoot' is an orebody of recognizable shape and inclination in a lode.

Those who consider such distinctions of no consequence will call a machine for getting rid of slime a 'slimer', ignoring the fact that the suffix 'er' indicates an agent, so that a 'slimer' is a thing that makes slime. The process of 'de-sliming' is conducted on a 'slime-table'. The same scribbler would talk of 'dewatering' a shaft, ignoring the fact that we use 'unwater' to signify that operation, while we use 'dewater' to indicate the removal of excess water in a pulp. Again, consider the difference between 'recovery' and 'extraction'. In subjecting a copper ore to concentration the percentage of the copper in the concentrate is a 'recovery', but it is not an 'extraction', for that is the work of the smelter. By using technical terms thoughtfully we increase our vocabulary; the careless use of words means the loss of distinct meanings; on the other hand the discriminating use of words assists accurate expression.

'Section' is often used improperly. A section is a division of the public land containing 640 acres. It is also the view along an imaginary slice of anything, like a geologic section or the section of a machine, intended to exhibit the interior. We ought not to use it as a synonym for 'region', 'district', or 'locality', as in:

(96) "The South-West is an arid *section* [region]."

(97) "In this *section* [district] the mines produce gold only."

Engineers should keep technical words for appropriate uses, otherwise they lose their special significance. A 'tunnel' is a gallery or bore that goes through a hill or mountain from

daylight to daylight, as a railway tunnel does. A level that enters a mountain from the surface, to become the main artery of a mine or to drain the water from the underground workings, without going through to the other side of the mountain, is an 'adit'—a term used by miners from time immemorial.

It is well to note that mistakes are rarely solitary; like sorrows "they come not single spies, but in battalions". Let me impress upon you the fact that if you are careless about one detail—apparently unimportant—you are likely to take no thought about others. Whether or not you accept my dictum concerning the use of this or that word or the rejection of this or that method of statement is of minor importance as compared with your acceptance of my general argument: that it is worth while to use words precisely and to build sentences logically. The man that learns to master the little words will acquire mastery over the big phrases. Genius has been called an infinite capacity for taking pains. The definition is incomplete, but it recognizes the first requisite of all good workmanship: the effort to be thorough.

XI. JARGON.

The dictionary defines 'jargon' as "barbarous or debased language". This description does not suffice. Quiller-Couch has said, it is "a kind of writing which, from a superficial likeness, commonly passes for prose in these days, and by lazy folk is commonly written for prose, yet actually is not prose at all." The two main vices of jargon, he says, are "that it uses circumlocution rather than short straight speech", like the Babu who reported his mother's death by saying: "Regret to inform you, the hand that rocked the cradle has kicked the bucket." Its other chief vice is that "it habitually chooses vague woolly abstract nouns rather than concrete ones", like the newspaper statement, "He was conveyed to his place of residence in an intoxicated condition", instead of saying, "He was carried home drunk." Jargon is "an infirmity of speech", it is not journalese, but akin to it. "Like respectability in Chicago, jargon stalks unchecked in our midst" and renders much technical writing ridiculous. It deals in periphrasis instead of going straight to the point, it loves the abstract rather than the concrete, it dabbles in words of sound rather than meaning. Avoid it, despise it, if you purpose earnestly to write well. "In literature as in life he makes himself felt who not only calls a spade a spade but has the pluck to double spades and re-double."*

Jargon is rampant in technical publications. Catalogues and other advertisements are conspicuous offenders, but with these the critic is not concerned, except in so far as such 'write-ups' pretend to follow the style set by technical journals and by the transactions of technical societies. Here is an example, taken from a reputable paper:

* These quotations are from a lecture delivered at Cambridge by Sir Arthur Quiller-Couch. 'The Art of Writing'. 1916.

(1) "The next proposition was to take out the rock to a depth of 20 ft. and build up an underpinning wall to carry the weight of the caisson and make the permanent seal to keep out all water. To avoid the possibility of jarring loose any of the temporary sealing blocks or breaking back under them the rock which was of a slatey nature, this excavation was started by channeling out for a depth of 5 ft. all around the shaft about 1 ft. inside of the blocking. The rock was then taken out in the ordinary manner with two shaft-bars and four rock-drills in operation. To further prevent the jarring of this blocking the rock was taken out in 5-ft. benches only. This made the work necessarily slower, but it was deemed advisable and so proved, for, notwithstanding the care exercised, certain leakages occurred which made the rock excavation slow on account of the shifting of pumps, taking off and putting back suction pipes, etc. This rock, as above mentioned, was a species of sand slate which would break back a considerable distance from the line of holes."

I shall not attempt to revise it, for it needs to be re-written by one possessing the detailed information that the writer has attempted, unsuccessfully, to impart. To many it may not seem utterly bad, but it is obvious that only absolute need of the information would induce anybody to read it.

The foregoing example shows how the English language is mishandled in America; now I shall give you an example to show how our language is maltreated in the country of its origin. The following quotation is taken from a book on petroleum recently published in London.

(2) "In this vaporizer, which works efficiently with any of the refined flash-proof lamp oils, the mixture is only heated to the comparatively low temperature of 300° to 400° F., in which connection it is well to understand that the more perfectly an oil is atomized the lower is the temperature necessary to its combustion, which is an advantage, if not off-set by the necessity for a more than corresponding complexity of apparatus, which in this case, as will be seen, requires an air pump and for

the fuel to be contained in a tank subject to a pressure of 8 to 15 lbs. per square inch; and this again obviously necessitates a separate hand pump, or a pressure supply for starting."

The errors are so many that the entire paragraph needs to be re-written. Why does he hyphenate 'flash-proof' and not 'lamp oils' and 'air pump' or 'hand pump'? He uses 'which' with irritating frequency; he employs the abstraction 'complexity of apparatus' instead of the concrete 'complex apparatus', besides a plain error of grammar, namely, "requires . . . for the fuel to be contained." The writer is an educated engineer, but he disregards the obligations of an educated man.

Here follows an attempt to describe the operation of a machine-drill in a mine:

(3) "Following the shooting, the *mucker* begins his work, the drill man climbs to the top of the *muck*, and by the time the four feet of ground shot down is *mucked out*, he is again ready to shoot his round of holes."

"Muck", "muck", "muck"—it is the very muck of writing. The word means filth or manure. It is used as a synonym for 'dirt', the miner's term for broken rock. Thus 'muck' refers to the shattered rock resulting from blasting, which is not in the least filthy. *Shovelers*, that is, those who shovel the broken rock into the car at the face of a level or cross-cut, are now called 'muckers'. What gain is there? 'Shoveler' is significant, 'mucker' is the rubbish of words.

The next example comes from a description of the small locomotives used in mines. It reads:

(4) "Face gathering, wherein the locomotive must enter the room, imposes conditions which call for distinctly special treatment in the design and equipment of a locomotive of high efficiency. The ordinary haulage locomotive in nearly all cases is totally unfitted to this work, which involves operation in narrow quarters, around sharp curves, over poorly laid tracks, etc. The locomotive of real value in room work is one which, by reason of proportions and construction, will go wherever a mine car will run, and with equal facility. It must be compact,

no wider than the wheels, with short wheel-base and small wheels, and without long overhang at either end."

This is the sort of thing that makes a technical description seem like a cryptogram or a slab of picture-writing from Nineveh. To any one versed in the subject of locomotives for underground use, this paragraph is intelligible, but only that. It succeeds in making the subject as uninteresting as possible and places the meaning as much beneath the surface as the locomotive itself.

The last two examples come from 'write-ups', the trade name for a eulogistic description of a manufactured article, prepared in the interest of the manufacturer and written by a man more accustomed to the use of a screw-driver than a pen. The worst writing concerning technical matters is to be found in such disguised advertisements. They ought to be attractively written, to serve their purpose; in failing to do so, they illustrate the essential ineffectiveness of bad writing.

Grammatical correctness is no excuse for a statement that is likely to cause trouble to your reader. He must have your consideration always if you expect to be recognized as an effective writer. A technical journal states:

(5) "The specifying by a mining company that no man may be employed by it unless he be a member of such an organization, though undoubtedly legal, is as contrary to social justice as the specifying that no member of any organization will be employed, or the refusing to recognize any employee as representing anyone or anything except himself as an individual."

That reminds one of a passage in 'Alice in Wonderland'; "Never imagine yourself not to be otherwise than what it might appear to others that what you were or might have been was not otherwise than what you had been would have appeared to them to be otherwise."

Here is more technical writing of a supposedly serious sort:

(6) "The expenditure involved is only justifiable with the assured certainty of very large ore reserves having values materially above operating costs."

"The expenditure involved would be justified only by the certainty of an adequate reserve of profitable ore."

A respectable engineer writes:

(7) "They would go to the lay-out and see if it was checked out; if found out to be laid out, the lay-out foreman would spend his time in looking for it, and if he could not find it he would get out a new one."

Such stuff is a disgrace to the profession; moreover, it is proof of such want of intellectual power as to argue against the possession of technical understanding.

Shun outworn figures of speech, like 'a bolt from the blue', 'the swing of the pendulum', 'the cry is still they come', 'after us the deluge', 'the Mecca of their pilgrimage', 'the Phoenix from his ashes', 'open Sesame', and 'the labors of Hercules'. They rarely give point to technical description; usually they are mere tags, in the reporter's style—a style to be scrupulously avoided in technical writing. Abstain from the use of such verbal inanities as 'festive', 'pristine', 'erstwhile', 'materialize', and 'eventuate'. These are precious to the reporter, but taboo to the intelligent writer.

Take note of the fact that nonsense remains nonsense however much you may disguise it in a veil of words. We think in words, and when we lack clear words we lack clear thoughts. Clear thinking is necessary to effective speech or writing. The forceful utterances and keen analyses to be remarked occasionally in men devoid of academic training show that the question of clear statement depends upon logic. Correct speech—grammatical speech—is logical speech. The following is a quotation from an address delivered by a prominent financier in San Francisco:

(8) "Let us learn, then, to realize that each has his dominion and his empire of domination, in which by the exercise of these qualities that are alike in spelling success each may rise to a position of leadership, with potentialities of power as great in its sphere of action as that one of the many, to whom we look for the time being, because of some particular preferment as a leader."

This is balderdash. It is "the delirious trimmings" of language.

Early Victorian elegance has no place in technical writing; for example:

(9) "The ore was relieved of its moisture through the medium of drying kilns." Meaning that:

"The ore was dried in kilns."

Nor do we want late Nevadan uncouthness:

(10) "*With the installation* of the new air-compressor underground development is being *prosecuted* more rapidly."

Is the air-compressor underground or is it being used for development underground? Should a comma be before or after the word 'underground'? The rapid progress is not being made "with the installation" of anything, but by the new compressor, operating more machine-drills. You do not *prosecute* a development; for that involves the pursuit of an abstraction.

(11) "The tributer is assisted in *the prosecution* of his work by being given supplies."

'Prosecution,' in this context also, is a foolish word, apart from being an abstract noun. Slovenly writers who use such words also use too many others. He meant to say:

"The tributer is assisted in his work by being given supplies"; meaning candles, dynamite, caps, and fuse.

(12) "Gold Mountain was turned down by *a succession* of eminent engineers." It would be more to the point to give the names of some of the engineers.

(13) "He extracted the gold in the residue, thus *doing away with* [obviating] the *necessity for* [need of] re-handling it."

It was not the 'necessity', but the 're-handling', that he wished to avoid. Was it the gold or the residue that he was trying not to 're-handle'? He meant to say: "He extracted the gold in the residue, thus avoiding re-treatment."

Slovenliness in writing is due not to poverty of ideas but to careless thinking. It may escape censure because the majority of readers are uncritical and too patient. Given a careless

writer and an equally careless reader, you have a performance about as profitable as a lecture to the deaf.

(14) "The Lake Superior copper mines are making a good recovery from the disorganized condition in which the long persistence of the strike put them."

Here you have the abstract phrases "the long persistence" and "making a good recovery" instead of a concrete statement saying that the strike had lasted long and that work at the mines had been resumed. 'Mines' is not the real subject of this statement, but the work being done in them. He—and he was an editor—meant to say:

"The working force at the Lake Superior copper mines is being re-organized and operations are being resumed after the long strike."

Statements that seem intelligible and are accepted by the patient reader without protest may yet fail to convey information accurately; and the docile reader—for every man that submits willingly to the attraction of an article, and reads it, is in a docile mood—either loses interest presently because of the vagueness of the discourse or struggles against the obstacles of clouded style until he is inclined to attribute the difficulty to a temporary mental inability of his own. The headaches of young students in their struggle to conquer knowledge from text-books are due more to the defective literary technique of the writers of the text-books than to difficulty inherent in the subject or to stupidity on the part of the learners.

(15) "The vein is a quartz fissure with a width of 1 to 6 ft., a dip of 50° to the north, and a filling of galena, sphalerite, pyrite, and chalcopyrite."

How can it be a fissure filled with quartz—for that is a quartz fissure, not a fissure in quartz—if it is filled with the four other minerals specified? Nor is the fissure attached to a width or a dip. He meant:

"The vein is from 1 to 6 ft. wide, it dips 50° north, and consists of quartz containing galena, sphalerite, pyrite, and chalcopyrite."

'Encounter' is a word greatly over-worked. It means to meet hostilely or in conflict. The use of it in varying senses tends to vagueness.

(16) "The rocks indicate to the miner when *encountered* the general lower limits of the volcanics."

He means that where (not 'when') a particular rock is found underground, there the lower limit (not 'limits') of the volcanic series is indicated. Therefore he might have said:

"These rocks, wherever found in the mine, indicate that the lower limit of the volcanic series has been reached."

(17) "The ore-bearing volcanics are seemingly of *more importance to the district from a gold-producing standpoint* than was at first supposed."

He meant that the volcanic rocks had a greater influence upon the deposition of gold in the district than had been supposed. He used 'seemingly' three times in eight lines of his manuscript, and you can infer from that how careless he was.

(18) "Some difficulties are *encountered* by the formation of sodium sulphate in the roasting furnace, *which dissolves together* with the sodium chromate."

Here 'encounter' means 'caused'. The wrong use of 'which' makes the writer state that the furnace 'dissolved'. The omission of the hyphen suggests that the furnace was 'roasting'. 'Together' is redundant. What he meant to say was:

"During the process of roasting, sundry difficulties are introduced by the formation of sodium sulphate, because it dissolves with the sodium chromate."

All these pluralities, generalities, and abstractions are the mark of jargon. As Quiller-Couch says: "To write jargon is to be perpetually shuffling around in the fog and cotton-wool of abstract terms: to be forever hearkening, like Ibsen's Peer Gynt, to the voice of the Borg exhorting you to circumvent the difficulty, to beat the air because it is easier than to flesh your sword in the thing."

Avoid extravagance. One of the chief obstacles to precision

in writing is prolixity, the employment of superfluous words. Shy at such phrases as 'with regard to', 'in respect of', 'at the same time', 'as a consequence of', 'in connection with', 'from the standpoint of', 'on the basis of', 'of such a character', 'to any extent', 'according as to whether', 'on the whole', 'more or less', and so forth. Occasionally one or another of these unlovely locutions may be useful or necessary, but resort to them grudgingly, treating them as first cousins to jargon, which is the newspaper prostitution of our language.

(19) "*With regard to* the process, the principal difficulty that arose *in connection with* the operation of it was *the large amount of dust*; the success of it therefore depended *as to whether* it could, *or could not* be collected without incurring *a more or less* prohibitive expense."

The 17 words underlined are mere 'empties' in the train of thought. Note too the careless use of 'it'; the first and second refer to 'process', but the third refers to 'dust'. He might have said:

"The success of the process depended upon the economical collection of the dust made during the operation."

(20) "*For it is well known that* man's methods are ever changing while Nature's laws upon which they depend are *invariable*."

Two unnecessary and insipid clauses are interjected under the false impression that they give dignity to the statement. How much stronger it sounds thus:

"For while man's methods are ever changing, Nature's laws are immutable."

(21) "Mistakes in assaying are far commoner than is generally thought *to be the case*."

"Mistakes in assaying are more common than is generally supposed."

(22) "Perhaps a few notes *as to* some of my experience *in connection with* mining in Colombia will be of interest."

"Perhaps a few notes on my mining experience in Colombia will be interesting."

(23) "The special difficulty *in the case of* flotation arose *in connection with* the treatment of the concentrate."

This might be changed to

"The special difficulty in using flotation presented itself when treating the concentrate."

Or, preferably,

"The main obstacle to the use of flotation was difficulty in treating the concentrate."

(24) "Any lumps of *more or less* [nearly] pure chalcocite were but superficially altered."

A mining journal says:

(25) "A *particularly* striking thing of the last Anaconda report is the exhibit of that company as the great metallurgical concern *that it is*."

The superfluous words are indicated. The statement can be amended thus:

"The latest Anaconda report exhibits that company as a great metallurgical concern" or

"This report exhibits the Anaconda as a great metallurgical enterprise."

Another author wrote thus:

(26) "So far as the writer is aware, the process has not been applied to any ore in this country, but there *can be no doubt that there* are many *instances where* it could be successfully applied."

This is a windy performance. What he wanted to say was: "So far as I know, the process has not been tried in this country, but there must be many ores to which it could be applied successfully."

(27) "Probably flotation is due to a combination of phenomena *which* [that] are *rather high in the scale of* complexity."

"Probably flotation is due to a combination of complex phenomena."

(28) "*From the standpoint of* [according to] this theory."

(29) "This is too important a matter to be treated *from a careless point of view* [carelessly]."

(30) "*From a genetic point of view* the genesis of the coralline limestone have [has] been most carefully studied." Delete the words italicized.

The last three examples are borrowed from 'Suggestions to Authors' by George M. Wood, the editor of the U. S. Geological Survey.

Such words as 'case', 'instance', 'nature', 'degree', 'character', and 'condition' should be used sparingly and with discrimination.

(31) "So *in the case* of these veins we *have present a reversal of the unusual case* where native copper turns to sulphide in depth."

This statement is typical of a kind of jargon that masquerades as ornate speech. He meant to say:

"Thus these veins reverse the experience usual in mining, namely, the change from native copper to sulphide mineral in depth."

(32) "*In the case* of copper it is not advisable to leach the ore."

"It is inadvisable to leach the copper ore."

(33) "The surface is *of a very uneven character*."

Delete the words italicized.

(34) "The *soft nature* [softness] of the rocks."

(35) "The lowlands in some *cases* [places] contain lakes, the most conspicuous *instances* being Crystal, Glen, and Portage lakes.

Here 'instances' is an elegant variant of 'cases'. It should be deleted.

(36) "This is the only *instance* in the district *of a* copper mine that is wholly in the granite."

"This is the only copper mine in the district that is wholly in the granite."

(37) "*In every case* an alteration product should be identified with extreme care." Delete the words italicized.

As Mr. Wood suggests, the victim of this habit of using 'cases' and 'instances', or some other similar abstract term,

should ask himself what he means by the word. What is the concrete thing about which he is writing? He is likely to discover that he is indulging in mere verbiage.

(38) "The miners returned to work in most *instances*."

They went to work in overalls. He meant: "Most of the miners returned to work."

(39) "Even in Carboniferous areas, only in one or two *instances* do the veins carry ore."

Substitute 'places' for 'instances'. Perhaps he means "only one or two veins carry ore."

(40) "The accident was due to the dangerous *nature* of the work and the fissile *character* of the rock."

It was not; the accident was due to the weakening of the rock by fissuring and the sudden fall of a large piece upon the miner working below.

(41) "A singular *degree* of mineralization marks the district."

Meaning that "intense mineralization characterizes the district."

(42) "The auriferous mineralization is distributed throughout the ore and consists of metallic gold and gold associated with iron pyrites."

This is thoroughly bad, from beginning to end. 'Mineralization' is the condition of being mineralized; how can a condition be 'auriferous', that is, gold-bearing. Next, how can 'mineralization' be distributed throughout the ore; it is an abstract idea; he means gold, thus:

"The gold in the ore occurs free and associated with iron pyrite."

The word 'situation' is beloved by jargoneers; it is a type of the abstract, of the general, and of the woolly.

(43) "To meet this *situation* [difficulty] as it developed, *sand-filling* [the filling of stopes with sand] was introduced in 1908." The same writer continues:

(44) "Previous to this date some of the older mines had been showing signs of movement, and it became evident that

preparation was necessary *to meet this tendency*, which was bound to increase in intensity as mining progressed."

'Tendency' goes well with 'situation'; both are abstract terms, the mere fog of an idea. He meant to say:

"Previous to that year some of the older workings had shown signs of movement, so that it became evident that a systematic effort must be made to check the settling of the ground, a condition sure to become worse as mining progressed."

(45) "He first went to Goldfield to examine a *mining situation* [mine] and then *located* [remained or resided] there for good."

To examine a situation is like fighting a chimera.

"He first went to Goldfield to report on a mine, and decided to live there."

(46) "This serious *situation with respect to dye-stuffs* has been splendidly met by the chemists of the country."

"This serious need of dye-stuffs has been met splendidly by the chemists of the country," or

"This serious deficiency in dye-stuffs has been overcome with splendid success by the chemists of the country."

(47) "The *situation in regard to fuel* is so alarming as to call for the most careful consideration."

He means: "The shortage of fuel at this time is so alarming as to demand serious thought."

The same writer continues:

(48) "Our *greatest* [best] opportunity for *success in meeting the fuel situation* [escape from the dilemma] lies in efficient combustion."

A mining lawyer writes:

(49) "An apex could not exist *in situations* [under conditions] *not greatly dissimilar* [similar] to those in the Jim Butler case."

(50) "The labor *situation* is passing through a period of unrest."

'Situation' is a mere abstraction; it is 'labor' that is un-restful.

(51) "He took an option on an *interesting situation* [promising prospect] on Canyon creek."

(52) "He liked the *situation* [the mine or property] and decided to invest his money in it."

Probably he speculated with his money; to the unthinking a 'speculation' is synonymous with an 'investment'.

(53) "The easing *up* of the oil *situation* was in sight."

"The passing of the crisis in the oil industry was assured."

As might be expected, the jargonist loves such an abstract term as 'values'.

(54) "In my tests made with a view of [to] studying the form in which *lay the values* [the gold and silver exist] in such tailings I have been unable to detect any *values* [precious metals] in the tailing from our ore."

How would he make tests to determine "the form" of the gold and silver until he had ascertained the fact that they existed in the tailing? When a writer makes such statements, he is not to be trusted.

'Problem' is another word dear to the jargonist in search of abstractions with which to obscure his want of accurate knowledge.

(55) "One of our serious *problems* is clean water."

He means: "One of our chief hindrances (or handicaps) is the lack of clean water."

(56) "*The problem presented by this difficulty engages the attention of metallurgists.*" Delete the words italicized.

(57) "The water *problem* is a drawback to concentration."

"The large amount of water required is an obstacle to concentration."

'Standpoint' is a jargonistic decoration.

(58) "The portion of the range that is of interest *from an economic standpoint* extends due east and west about six miles."

"The portion of the range that is of economic interest extends due east and west for six miles."

'Eliminate' is another first cousin to jargon.

(59) "The presence of barite or gangue will in most cases *eliminate the possibility of using gravity concentration.*"

He was writing about oil-shale.

"The presence of barite or other heavy minerals will usually prevent the use of gravity concentration."

(60) "One company has succeeded in treating this shale in a small retort, and is *contemplating the installation of [planning to erect] a larger plant.*"

To 'contemplate the installation' is pure jargon.

(61) "The method has been employed *in connection with the Herreshoff furnace installation.*"

"The method has been applied to Herreshoff furnaces."

(62) "The *problem* of water-losses was taken up coincidentally with the stack-loss determinations." He is referring to the metallurgy of quicksilver.

"The loss in water was investigated at the same time as the loss in fume."

It is likely that many of the examples quoted by me will seem to you by no means bad; in fact, they represent the kind of writing that is so common as hardly to call for comment by those whose critical faculties have not been awakened; yet, I assure you, the avoidance of just such jargon is essential to good writing. Jargon defeats its purpose; the thought fails to reach its destination; the cross-currents distract the tired reader's attention, they interrupt the voyage of his thought, which drifts with the flux of words and becomes stranded at length on a shoal of verbiage. Brevity is the soul of wit; conciseness is the essence of clarity; every unnecessary word tends to obscure.

XII. THE CONSTRUCTION OF SENTENCES.

In order to write clearly—that is, so as to be understood beyond question—you should know not only what your words denote but how to build your sentences: you must not only choose your words carefully but you should construct your sentences properly. To achieve proper construction, you must obey the laws of syntax, because the meaning of clauses and sentences depends upon the order of words. A sentence is a combination of words that expresses thought: it says something about something. A clause is a subordinate sentence; it is part of a larger sentence. The Greeks call an editor a *συντακτής* (*süntaktēs*), he who assembles the parts of a sentence. Hence our word 'syntax' for the branch of grammar that treats of the sentence and its construction. English is essentially a non-inflected language; and in that respect it is unlike not only Latin and Greek but its modern rivals, French and German. This lack of inflections, to indicate the relation of words, makes it supremely necessary that in English our words shall be placed in correct order, for we depend upon the order to indicate the sequence of thought. Any deviation from the logical sequence may endanger the meaning; for example:

When spies were feared in England at the beginning of the War a local paper stated:

(1) "The authorities are now looking for a gray motor-car driven by a woman who is thought to have a wireless apparatus inside."

A technical journal announced:

(2) "We publish an article on errors latent in the sampling of mines by Mr. Blank." The mention of the author should have followed "article".

(3) "He blew out his brains after bidding his wife good-bye with a shotgun."

(4) "Mrs. Smith was killed on Wednesday morning while cooking her husband's breakfast in a shocking manner."

(5) "The owner of this property fishes and shoots himself."

(6) "The concentrating table was covered by the foreman with a new face of rubber."

(7) "The samples were preserved for analysis in a paraffin-sealed flask."

(8) "Care should be taken to see whether such wells are contaminated by frequent analyses."

The foregoing examples of incoherence break the rule that "the relation of each word and each clause to the context should be unmistakable." Another rule says: "Clauses that are grammatically connected should be kept as close together as possible." As a further warning I quote the following:

(9) "The expedition, which left Fairbanks March 13, expected to reach the summit of Mt. McKinley early in May, but was delayed three weeks cutting a passage three miles long through ice with hand-axes thrown across the ridge by an earthquake last summer."

That must have been a weird earthquake! it threw hand-axes across a ridge! Even if you place "with hand-axes" after "passage" you find yourself saying that the hand-axes were "three miles long". Note the slovenliness of style: the omission of 'on' before "March 13," of 'while' before "cutting", and of 'it' before "was delayed". The statement can be amended thus:

"The expedition . . . was delayed three weeks by having to cut with hand-axes a passage three miles long through ice, which had fallen across a ridge in consequence of an earthquake last summer."

Place clauses in their logical order; the inversion of ideas is confusing.

(10) "Combined with geological ability of an unusual degree, he was an all-around engineer."

No sensible man talks in this way; the phrasing is stilted and obscure. It is better to say:

"He was not only an all-around engineer, but also an excellent geologist."

(11) "Due to the richness of the new orebody on the tenth level, the mine has paid dividends." He means that:

"The mine has been able to pay dividends, thanks to the richness of the new orebody on the tenth level."

(12) "Compared with what I had seen in Nevada, Rhodesia is a poor goldfield." This may be changed to:

"I would consider Rhodesia a poor goldfield, as compared with Nevada."

Take care that your demonstrative pronouns are made to refer to the right thing.

(13) "A number of mines have adopted the use of cars to take the place of 'cans'. *These* hold from 1500 to 2000 lb. apiece."

The second sentence refers to the 'cars', not the 'cans'.

"A number of mines have substituted cars for cans. Each car holds from 1500 to 2000 lb." or

"In a number of mines the 'cans' have been replaced by cars, each holding from 1500 to 2000 lb."

(14) "Because a process is cheap does not prove it desirable."

(15) "It is because he was a scientific man that he insisted upon research."

In these two examples the causal clause is made substantive, thereby producing an awkward inversion. It would be better to write:

"A process is not desirable merely because it is cheap."

"He insisted upon research because he was a scientific man."

Kelley says: * "It should be insisted on again and again that if two forms of expression are both open to criticism, the chances are very large that something else could be better than either. Begin anew, and hammer out for yourself a sentence to which you can think of no reasonable objection. So a young

* James P. Kelley, 'Workmanship in Words'.

writer learns his trade, and so a veteran keeps his style fresh and clean."

I should delete 'on' after 'insisted'; also the 'very' before 'large'; again, I should avoid the preposition-verb 'think of' and say "a sentence to which you can see no reasonable objection". However, the advice is admirable.

Do not compare things with qualities, the concrete with the abstract. Correspondence in form promotes lucidity and ease of statement.

(16) "He saw these issues more clearly than any [other] man."

(17) "No *other* man in the country has done more to advance the study of economic geology."

In the first quotation the 'other' is needed; in the second, it is out of place.

An intelligent interest in the rules of composition need not stiffen the writer's manner, nor make him pedantic.

Connectives should be placed carefully, and when used in couples they must correspond.

BOTH, AND;

(18) "I went both because I feared and because I hoped."

EITHER, OR;

(19) "The division of profits made by *either* governments, banks or industries."

Delete 'either' and insert a comma after 'banks'.

NOT ONLY, BUT ALSO;

(20) "This was not only according to law, but also according to justice."

ON THE ONE HAND, ON THE OTHER HAND;

NEITHER HERE NOR THERE.

(21) Either in the city or in the country.

Do not omit to repeat the preposition.

(22) "Poets are either born in London or remote country places."

The 'either' is misplaced and 'in' is omitted before 'remote'.

"Poets are born either in London or in remote country places."

NEITHER, NOR;

(23) "I looked neither forward or back."

This likewise contains an error.

"I looked neither forward nor back."

These seem small matters to the slovenly writer, but they are of the essence of clear writing. As Kelley says:

"No great difference? There is no great difference between lifting two pounds and lifting one pound; but I will not have my shoes weighted with lead. In the single and simple case, no great difference; but construct a complicated sentence in defiance of the laws of thought, or a long discourse with constant disregard of what is normal in structure and formally clear, and the reader will be wearied and repelled unless your work is in other respects so good as to please him in spite of your slovenliness—and even if you please him, very likely you will have failed to make him understand you, and thereby to persuade or convince or instruct him as you would wish to do."

Young writers drift easily into long sentences, entangling their ideas in a wilderness of words. They shun the short sentence, preferring to link one thought to another by the aid of many 'ands', as an after-dinner speaker ekes out his lame remarks with a frequent 'urr' or 'err'. To err is human, to forgive divine; but it is hard to condone the unnecessary 'and'. Don't be afraid of short sentences or of using the period.

(24) "This quality of diffusion indicates molecular mobility; *and* a good example of this is furnished by etc."

"This quality of diffusion indicates molecular mobility, a good example of which is furnished by etc."

(25) "The methods employed in the underground work vary with the nature of the ore deposits *and* have been developed to suit the local conditions encountered in the various mines."

This is verbose and confused.

"Mining methods have been developed to suit local conditions, as modified by the varying structure of the ore deposits."

(26) "At the Zaaipplaats tin mine the cassiterite has mainly occurred in the Red granite; *and*, the author particularly notices that the color of granite round the pipes was often of a much deeper red; *and*, that a great deal of tourmalinization had taken place."

This requires several corrections: "At the Zaaipplaats tin mine, the cassiterite is found chiefly in the Red granite. The color of this granite is deeper in places around the pipes [ore-chimneys], where also tourmalinization is marked."

Such sentences are written by men that cannot claim lack of experience in writing. Here is a shocking example from the 'Times', of London:

(27) "The cities we remember from childhood, unvisited since, grow in our minds *and* become glorious *and* visionary. The memory itself is only a material which the mind uses, as in dreams it uses some fact of waking hours. There was a bridge, perhaps a mean iron bridge, *and* a few trees, *and* some decent houses beyond it. But all the mean details are forgotten, *and* the scale is so altered that the bridge seems to have spanned a deep valley with great arches, *and* to have been a causeway leading into a city of palaces *and* overshadowing trees. *And* along the causeway crowds were drawn into the city *and* traffic coming from a great distance, as if to a festival. *And* there is a memory also of the sky itself as momentous—towering clouds flushed with the sunset, *and* the causeway shining after rain, *and* all the people in the streets enjoying the beautiful hours, with music [that was really a German band] adding a glory of sound to the glory of light *and* form *and* movement."

The excessive use of 'and' spoils an excellent piece of writing.

'And' is used as a feeble continuative by writers uncertain of the relation between their ideas.

(28) "Jackson went *and* examined the pump." That

might be true; he might have gone toward the pump and then incidentally he might have examined it; but what the writer really meant was:

“Jackson went to examine the pump.”

(29) “He told him to be sure *and* [to] attend to this matter.”

(30) “When costs in California and Europe were compared—\$75 here *and* [as against] Spanish mercury imported at \$40 per flask—it became evident that an import duty was desirable.”

(31) “It *is sometimes* [may be] found that the screening from one lot of ore is sufficiently rich to be shipped with the selected ore *and* [whereas] that from the next lot will be too poor.”

(32) “Practically all the belts are 30 in. wide, 7-ply, *and* have $\frac{1}{8}$ in. rubber cover on the carrying side, *and* $\frac{1}{8}$ in. on the pulley side.”

We see what he means, but it can be said more clearly:

“The belts are 7-ply and 30 in. wide; they have a $\frac{1}{8}$ in. cover of rubber on the carrying side and $\frac{1}{8}$ in. on the pulley side.”

(33) “The mining world is indebted to the initiative of John Wiley & Sons for meeting so great a want, *and* they have been fortunate in securing the services of Mr. Peele as the guiding spirit to translate the conception into achievement.”

Here the ‘and’ is introduced to correct a badly organized statement. When re-written it reads thus:

“John Wiley & Sons have placed the mining world under obligation by their initiative in meeting so great a want, *and* they have been fortunate in securing, etc.”

(34) “Wet methods of treating the concentrate were not at all satisfactory, as there was a large amount of black residue in the concentrate that could not be decomposed by sulphuric acid and ferrous sulphate, *and which* carried high silver values.”

If ‘which’ is replaced by ‘that’, the last clause would refer back to ‘residue’, but the chief fault lies in tying an important assertion to the end of the opening statement by means of the ‘and’. He means:

"Wet methods of treating the concentrate proved unsatisfactory because it contained a large proportion of black residue, rich in silver, that could not be decomposed by sulphuric acid and ferrous sulphate."

(35) "It is obvious that the calculations can be shortened when one set of apparatus *and* conditions are used continuously for analyses."

He is connecting unlike ideas in a confusing manner.

"It is obvious that the calculations can be simplified by using the same apparatus under identical conditions during a series of analyses."

Sentences without logical connection should not be linked by a feeble 'and'. The reason for the connection should be made clear by using the proper connective or by inserting an explanatory clause.

(36) "For the retorting of lean shale, the Scottish retort gives fairly satisfactory results, but it is by no means perfect, *and* [although] it has been claimed that it is possible *to so* [so to] improve the retort as to make it less costly both to construct and to operate."

(37) "It is certainly not wise to construct small plants *which* are to be operated to recover both oil and nitrogen contents, *and* it will be especially poor business should it be also necessary to manufacture the acid required for the production of ammonium sulphate." I suggest:

"Certainly it is not wise to erect small plants that are to be operated to recover both the oil and the nitrogen contents, more particularly in a locality where it becomes necessary also to make the acid required in the production of ammonium sulphate."

Adjectives should follow each other in the order of thought.

(38) "The orebodies are easily mined and large."

The 'easy mining' is a consequence of 'largeness', and that is the order in which the adjectives should be given.

(39) "The ore is subjected to costly and prolonged treatment."

The idea of costliness follows upon the prolongation of the treatment.

Such inversion of adjectives is tiresome to the reader and detracts from the force of the statement.

Place subordinate words in less emphatic positions, leaving the important words where they are clear and disentangled from other words that clog them. Avoid emphasis on words that do not "deserve distinction." Monosyllables usually make a feeble ending for a sentence. Lord Shaftesbury, in his 'Advice to an Author', says: "If, whilst they [writers] profess only to please, they secretly advise, and give instruction, they may now, perhaps, as well as formerly, be esteemed, with justice, the best and most honorable among authors."

That is a complex sentence so well arranged as to be perfectly clear.

Adverbs are commonly misplaced. Put the modifying word as near as possible to the word that it modifies. "The ore should properly be dried" does not mean that "the ore should be dried properly". The first refers to the need of a particular operation, the other to the need of conducting the operation in a particular way. "The words and groups of words that are near to one another in thought should be near in expression, and those that are separate in thought should be separate in expression." *

(40) "Such errors are frequent in the writings *even* of good authors."

The "even" should follow "frequent".

'Only' and 'always' are commonly misplaced.

(41) "His exordium would have been admirable if *he only* had spoken; but Mr. Asquith's significant reference to future relations aroused speculation instead of stilling it." 'New Republic'.

'Only' should precede 'he'; the writer means that it would have been better for the purpose if Mr. Lloyd George had

* A. S. Hill.

been the only speaker. As it is, the sentence expresses the wish that he had spoken.

(42) "The internal-combustion engine has been introduced on a large scale in refrigerating plants *only* in the last three years." This is correct, but it would be clearer if the 'only' came after 'years'; the statement might be taken to mean "in refrigerating plants only".

(43) "It is necessary to *always* roast the ore before chlorination" and "It is necessary to roast the ore *always* before chlorination" are both objectionable. In the first, 'always' splits the infinitive; in the second, it qualifies the wrong word. The sentence should read:

"Before chlorination, it is necessary *always* to roast the ore." This introduces 'chlorination' ahead of 'roasting' and is preferable to "It is necessary *always* to roast the ore before chlorination," because the necessity for roasting arises from the use of chlorination; therefore the ideas should be expressed in that order. As a grammarian would say, "Before chlorination" is the antecedent clause, and "it is necessary, etc." is the consequent clause.

Do not bring two verbs, belonging to different sentences, into close contact, as in the following quotation from the 'New Republic':

(44) "What the more serious evils of that policy *are was* revealed by the election."

It were better to have written:

"The more serious evils of that policy were revealed by the election."

I shall not castigate the split infinitive; the use or non-use of it is a matter of taste. You should try not only to avoid splitting the infinitive but to keep your verbs intact. Thus do not say "The ore has never been so cheaply milled" but "The ore never has been milled so cheaply." In the first the verb "has been milled" is dismembered into three parts by the intrusion of the adverbs.

The split infinitive, however, is more than a breach of

good taste, despite the sanction of usage as cited by an eminent critic.* It suspends the sense. A similar error is that of interpolating words between the definite article and the noun, as in "the already deep shaft has been sunk another hundred feet." Those who write thus are also likely to say:

(45) "We today find nothing peculiar in this."

The emphasis is on 'today', which therefore should come first, instead of separating 'we' from 'find'. It is curious that such splittings, of the infinitive and of other verb phrases, are usually employed for emphasis, which can be obtained much better by other locutions. Such suspensions are "ugly in form as they are awkward in sense." †

Here is one from the 'New Republic':

(46) "Our men of wealth have accepted *profits and income taxation* with a better grace than those of any European nation, with the exception of England."

The reader wonders why it is necessary to say that rich men have accepted "profits and income", and is jarred by the statement, before he reached the word 'taxation'. The quotation is an example of sloppy writing. 'Rich men' is better than "men of wealth"; 'except' is better than "with the exception of". The writer wallows in indirect reporter-like phraseology. He might have written:

"Our rich men have accepted the taxation of their profits and incomes with better grace than those in Europe, except the English."

Similar suspensions are common in technical writing.

(47) "As between fine and coarse ore crushing, he recommended the Gilpin county type of deep-mortar long-drop stamps."

Here the interposition of "fine and coarse ore" suspends the sense until "crushing" is reached; similarly a long adjectival phrase intervenes between "recommended" and "stamps".

"As between crushing fine or coarse, he recommended

* Lounsbury.

† Allbutt. Op. cit. Page 82.

stamps of the Gilpin county type, that is, a deep mortar and a long drop."

(48) "In the hard ground at Miami it is advisable to use a *wide shrinkage stope and pillar* system."

Here the five words preceding "system" are used as an adjective, suspending the sense too long. It would be better to write "system of wide shrinkage-stopes and pillars".

(49) "In sending *in* orders it was *very* necessary to give *full shipping and marking* directions."

'In' and 'very' are redundant. The four words preceding 'directions' are an adjectival jumble. He might have written:

"In sending an order it was necessary to give full directions for shipping and marking."

Directness of statement is an aid to clearness. As Horn Tooke said: "The first aim of language is to communicate our thoughts; the second, to do so with dispatch."

(50) "So the new order strikes at the root of much of the difficulty that has disturbed the industrial world since the War began *by applying only to the unskilled.*"

The clause italicized should come after 'order', which it explains.

(51) "It might have been appropriate to have *developed* [provided that] these particular resources of manganese and platinum, so forcibly cited as an argument for shoving the Bill through the Senate, [should be developed] under the direct control and management of a Government bureau for the pecuniary benefit of the actual owners in law and equity."

Here the principal word 'developed' has been misplaced, so as to mar the directness of statement.

(52) "What is regarded as a significant fact is that as yet the President has not yet officially announced the re-establishment of the present price as effective from June 1 to August 15, although the War Industries Board has so recommended."

It was the disregarding of the recommendation by the Board that was the significant fact, therefore the statement should be re-arranged thus:

"It is significant that the President, notwithstanding the recommendation of the War Industries Board, has not yet announced the official re-establishment of the present price effective from June 1 to August 15."

(53) "An applicant had to file a copy of these regulations, to show that they had been complied with."

He means: "to show that he had complied with them."

(54) "Before a hole drilled in the manner described is blasted, the hole is sprung by exploding in the bottom of the hole several charges of dynamite."

The clause "drilled in the manner described" is interjected awkwardly; it is superfluous. The statement can then be corrected thus:

"Before the hole is blasted, it is 'sprung' by exploding several charges of dynamite in the bottom."

'Sprung' is treated as an unfamiliar term and is explained by the last clause; therefore the single quotation-marks are desirable.

(55) "After a hole has been chambered sufficiently, the amount of which depends on the depth of the hole, the hardness and the tenacity and the volume of the rock to be broken, the hole is loaded for the final blast."

This statement contains several unnecessary inversions. The comma after the second 'hole' is not followed by a second comma after 'hardness', so that the continuity of the statement is broken. He might have written:

"The hole is loaded for the blast after it has been chambered sufficiently, this depending upon the depth of the hole, as well as upon the hardness, tenacity, and volume of the rock to be broken."

You will find it advantageous to place sundry adverbs, especially those of time or place, either at the end or at the beginning of a clause, gaining emphasis thereby. Thus:

(56) "Lately the ore has been crushed to 100-mesh" or
"The ore has been crushed to 100-mesh lately."

The first is preferable; either is better than

“The ore has lately been crushed to 100-mesh.”

(57) “The vein is frequently faulted along the upper level.”

Here the idea to be expressed is the repetition of faulting particularly on the upper level, therefore re-arrange thus:

“Along the upper level, the vein is faulted frequently.”

So the most significant words are placed in the most prominent positions, at the beginning and at the end of the sentence. ‘Along the upper level’ and ‘frequently’ are emphasized. But ‘frequently’ carries the idea of time; substitute ‘at many places’.

Aim at correct emphasis, but do not carry the effort to the extent of cultivating a mannerism. My purpose, in analyzing the foregoing examples, is to suggest the undesirability of separating the parts of a verb by an adverb or an adverbial clause. It has become common to say:

“It certainly is”

“It sure did”

and it is just such vulgarisms that mislead the student into illiteracies from which he finds it difficult to escape.

The habitual use of slang, including a decorative kind of profanity, is detrimental to the acquirement of skill in the correct expression of ideas. Slang beggars the vocabulary; profanity ignores it. The word ‘damned’ has to stand for a host of adjectives and things ‘go to hell’ in a thousand ways.

XIII. COMPOSITION.

Do not write until you have something to say. Think first; then write. In order to be understood, you must know what you wish to say. Clear writing is the consequence of clear thinking. Therefore consider your subject well before you begin to write; ruminates on it; marshal the salient facts in your mind; saturate yourself with the ideas you wish to express and with cognate ideas; then express yourself deliberately. If you are bubbling over with your subject the words will come, but you might as well expect to sail without a breeze as hope to give life to words without the living thought.

Endeavor to visualize the things to be described; consider their relations to one another; let your mind dwell upon the particular phase of their relationship that is to be the subject of your writing. Then prepare an outline of the argument or of the successive stages of the description. Begin the writing with a general statement of the subject to be discussed. Try to strike a clear note; do your tuning where it will not annoy the reader. After making the general statement, proceed to details. Make them vivid; keep them distinct. Then draw your inferences and play upon them until they lead naturally to a definite conclusion, which should embody the purpose and purport of what you have written.

Before beginning to put your ideas in writing, charge your memory with the words, technical terms, and phrases that will furnish the means for effective expression. To acquire an adequate vocabulary, read what others, preferably good authors, have written on the subject or on a kindred subject. An artist is not expected to utter the message in his soul until he has mastered the technique of his instrument, neither can a writer be expected to express thought fluently and pleasantly without acquiring the technique of language.

Let Macaulay be your model. Professor Hill says of him: "What he saw at all he saw distinctly; what he believed he believed with his whole strength; he wrote on subjects with which he had long been familiar; and he made lucidity his primary object in composition. For him, in short, there was no difficulty in securing clearness except that which is inherent in the nature of language. This difficulty he overcame with unusual success, as all his critics admit, and one of the severest of them, John Morley, says that he 'never wrote an obscure sentence in his life'."

Sentences are said to be of two kinds, the periodic and the loose; but this dictum serves only to illustrate the fallacy of dichotomous division, even though it have the authority of all the rhetorics to back it. The foregoing statement was constructed as an example of the so-called 'loose' composition, because the sense is not sustained unbroken to the end; it could have ended at an earlier pause. A periodic sentence is a product of the art of neatly packing the items that it is to carry in such a way as to leave no loose ends. The foregoing sentence is 'periodic'—that is, it ends with the completion of its period. However, the terms 'periodic' and 'loose' are generally applied to longer and more complex sentences. All good sentences should show a careful ordering of their parts with a view to effective expression. To follow persistently one form of construction savors of affectation. Both forms have their charm when used by a master; both are used variously by every author. Model your style on Macaulay rather than on Meredith, on Emerson rather than on Henry James.

Short sentences are easier to write and easier to understand than long ones. "The longer the sentence the more arduous its architecture."* The long sentence is difficult to manage, but it enables the writer to assemble a group of related ideas into a coherent whole and to make a complete unbroken impression. Variation in the length of sentences is essential to an agreeable style. Avoid an excess of short asthmatic sen-

* Allbutt.

tences; avoid also long sentences that are packed with a mass of unsorted and unrelated ideas.

A paragraph should be devoted to one main idea, and it should either begin by introducing the idea that it is intended to develop or its beginning should suggest the direction in which the thought is to move. Here again Macaulay is a good exemplar; so is Ruskin. The end of the paragraph, or the last sentence, should complete the preceding thought and bring it to a definite conclusion. The thoughts expressed in the intermediate sentences, not too insistently, linked by well-chosen connectives, should pass by easy transition through successive steps in the climax to the conclusion. "In Shakespeare one sentence begets the next naturally; the meaning is all inwoven. He goes on kindling like a meteor through the dark atmosphere." *

Technical writing is devoted largely to description and exposition. "Good arrangement is at least one-half exposition. Order is often equivalent to explanation." In describing a machine it is advisable to consider the parts in logical order, that is, in the order in which they are set in motion. In describing a mill the description should follow the flow-sheet. In explaining the origin of an ore deposit the physical processes and geologic movements supposed to have been at work in the making of it should be discussed in the sequence of their natural operation.

Comparison is indispensable in technical description. By references to similar things the reader is helped to understand the thing described. An ore deposit is elucidated by mentioning its points of similarity and dissimilarity as compared with other deposits likely to be known to the reader. Machines and processes are made intelligible by comparing them with those with which the reader and the writer are both familiar. Facts by themselves have little meaning; it is in their relation to other facts that we find their true significance.

* Coleridge. 'Table Talk'.

The poor quality of much of the technical writing of today is due, I believe, to the intervention of the stenographer. Dictation tends to develop diffuseness and repetition. Many find it easier to use the mouth in talking than the hand in writing. That is why the average dictated letter, unless it be edited and re-written, is verbose. An author who uses pen or pencil can see what has gone before and can compose with a consecutiveness that is conspicuously absent in a dictated composition. Technical men accustomed to dictating their correspondence find it difficult to write an article in long-hand; so they dictate the article also; and the consequence is that the article resembles the dictated letter in failing to be closely knit, clear, or logical. Henry James is said to have dictated his later writings, and this may account in part for their involved style. My own practice is to write with a soft pencil on paper that is not too smooth. The dipping of a pen into the ink introduces an artificial interruption—annoying if it comes in the middle of a sentence. Besides, the point of the pen being hard, the fingers soon tire. The penciled manuscript is given to a typist, and the clean typewritten copy is then revised carefully before it goes to the composing-room. The first draft, the typewritten copy, the printer's proof, each, in turn, represents a stage of increasing dignity in the development of an article. The earlier a correction is made the better. In former days many of the minor corrections, of spelling and punctuation, even of grammar, were made in the composing-room or the printing-office. The real editors were the typesetters or the proof-readers. But that practice is becoming obsolete.

Some writers find it convenient to jot down notes on separate cards or small sheets of paper and then arrange them in orderly sequence. I advise you to try this method. Others, especially the more practised writers, dispense with such aids. As a rule, the beginner will be wise if he prepares an outline of what he intends to write, so as to give sequence and proportion to his treatment of the subject.

Clever men think more rapidly than they can write; stupid men write more rapidly than they can think; a good writer will form the habit of regulating the speed of his thinking so that it keeps step with the order of his writing. The ability to synchronize the movements of the brain and of the hand is acquired by experience, which, in time, creates a habit. As Ben Jonson said: "The best writers in their beginnings imposed upon themselves care and industry; they did nothing rashly; they obtained first to write well, and then custom made it easy and a habit. By little and little their matter showed itself to them more plentifully; their words answered, their composition followed; and all, in a well-ordered family, presented itself in the place. So that the sum of all is, ready writing makes not good writing, but good writing brings on ready writing."

XIV. STYLE.

Technology has no recognized rank in what is called polite literature; the subject-matter of engineering is not supposed to lend itself to artistic treatment: we are the hewers of wood and drawers of water to the high-priests of learning who live on the cold summit above our humbler dwellings. Therefore the hierophants smile at the notion of 'style'—“that curiously personal thing”—in technical writing. The “great art” of Pater, the “inevitable phrase” of Raleigh, the “note of distinction” that Arnold demanded, are said to be beyond the scope, as they are supposed to be beside the need, of a writer on geology or engineering. This is a narrow view. Science, no less than *belles lettres*, calls for the highest flight of the human intelligence; the art of writing should be employed as skilfully and as thoroughly in a description of the structure of the Sierra Nevada, or of the construction of a tunnel through the range, as in a rhapsody welcoming the rosy fingers of the dawn.

The idea still lingers that fine writing does not befit technology, even though the masters of the Victorian period—Huxley, Tyndall, Ruskin—proved that science is worthy to be arrayed in the best robes that the looms of thought can weave. At the beginning of these lectures I quoted Barrie's remark touching the inability of the scientific man to express himself. That imputation has been passed to the technologist, whose utilitarian pursuits are supposed to make him too clumsy for the refinements of human speech. We may not have acquired the self-consciousness of those writers on Art whose “power of expression is so cultivated that their sensual caterwauling may be almost mistaken for the music of the spheres”; nor can we imitate the politicians, who have the ability to speak far beyond anything that they may have to say; but we too have a literature; a literature that is a gold mine of human experience,

and we have a conscious aim to use our great inheritance, the English language, in furthering our purpose. Therefore, I submit, we are justified in discussing a matter even so recondite as 'style'.*

The engineer joins the essayist, the historian, and the poet in bowing to the greatest of all definitions of style: Buffon's "*Le style est l'homme même*"—style is the man himself. Good writing is natural; great writing is sincere. Artificial rules can no more furnish style than a man "by taking thought can add one cubit unto his stature." Not long ago I had the pleasure of editing an article on the discovery of cyanidation contributed by one of the originators of that process. The article was written without affectation, with a directness and a charm characteristic of the author of it. A correspondent in Australia wrote saying: "The charm of which you speak is characteristic of all good writing, whether on familiar or professional subjects. One might also conclude that such qualities of sincerity and kindness alone can account for literary excellence." The persons concerned in this story are not famous—it was not Tyrrell talking to Carlyle about Swift, for example—but the episode serves to explain Buffon's saying "Style is the man himself." Buffon also said: "Ideas alone are the foundation of style", and Stevenson left a saying that is worth many rules: "If a man can group his ideas, he is a good writer." Without the ideas to bind his assorted facts, the writer fares no better than the Israelites in Egypt when they were expected to make bricks without straw. Given the ideas, the next step is to group them so as to achieve that "perfect lucidity" which Carlyle imputed to Swift. Then comes the search for the fitting word—"le mot propre" of Flau-

* "The word 'style' is derived from the instrument (*stilus*) of metal, wood, or ivory, by means of which, in classic times, letters and words were imprinted on waxen tablets. By the transition of thought known as metonymy the word has been transferred from the object which makes the impression to the sentences which are impressed by it, and a mechanical observation has become an intellectual conception." Gosse. 'Encyclopedia Britannica'.

bert—the word that belongs to the thing described, the precise epithet. This was one of Shakespeare's great gifts. So, working backward, we have the proper word, the word in its right place, the idea that gives life to a sequence of words, and, behind all, the soul of a man.

You may have heard of the author that was obsessed by an unattainable ideal of style. James Huneker tells us that he dreamed of "long sweeping phrases, drumming with melody, cadences like the humming of slow uplifting walls of water tumbling on sullen strands". Do not permit yourself to entertain such an idea; it is not within the province of the technical writer, and will lead only to insincerity. Sincerity is the keynote to good writing. Those "lines of chiseled beauty" will come if you attend to the fundamentals and abstain from rhapsody. Anything like a personal or distinctive style cannot be acquired until you have trained yourself to control the gift of expression.

This advice on 'style' may seem premature; it may be like some other "road-maps to Parnassus that are useful only after you have got half-way up"; but I repeat: be natural; be yourself; shun artifice; avoid affectation; say frankly what you know or what you have observed; use only words the meaning of which you know; avoid purple patches and rhetorical confectionery. Group the composition about the central idea. Be satisfied with short sentences until you have gained the experience that enables you to swing the longer ones dexterously. As you gain experience, vary the length of your sentences; the crisp sentence is a relief; the long and resonant period is delightful. Make the thought consecutive and place the sentences in such order that the succession of ideas leads naturally to a definite conclusion.

Not all engineers are graduates of a university, and many of those who have been so fortunate as to receive a liberal education are not well trained in the use of their own language; they have not had such a training as is founded upon a knowledge of the languages of antiquity, supplemented by care-

ful reading of the English classics. To appreciate good writing keenly is a stimulus to developing one's own style. Such preparation is valuable, but it is not essential to the ordinary technical writer, provided he makes the most of his schooling and tries sincerely to avail himself of the means of expression at his command. University education rarely succeeds in producing men that write succinctly; intelligence and care—which is the supreme mark of intelligence—can accomplish great things.

Two examples will illustrate my argument. Several years ago I had to edit a long and detailed description of a metallurgical device and the operation of it. The article was eminently practical and businesslike. The subject did not permit any literary pose, yet the article evidently was the work of a capable craftsman. I found that it needed scarcely any editing, and when it was published I referred gratefully to the excellence of the writing. Happening to discuss the incident with a friend, I was asked by him to guess for what occupation the writer had been trained, and I said: "The ministry." This guess happened to be right, for the writer had been to Oxford and was intended for the Church before he wandered into a cyanide mill. The article bore the marks of the writer's training; a quiet command of English and a masterful use of it, making a difficult bit of technical exposition as clear and interesting as the subject permitted; and since "the home of lost causes" is not my *alma mater*, I may be permitted to acknowledge the value of Oxonian English in the literature of science.

My other example differs less than may appear at first sight. I have in mind an article describing mining conditions in a Central American republic. Such descriptions are usually made as verbally florid as the vegetation of the tropics and as involved as the jungle itself; at best, it is customary to bespatter them with unnecessary Spanish words and to deal in gorgeous generalities befitting the unlimited mineral resources of an inaccessible region. From these common faults this

article was free. The sentences were short and to the point. The statements conveyed information without exaggeration. The writer kept what he knew at first hand separate from what he had merely been told; he gave just the information for which the average intelligent reader would ask, and a touch of humor was not lacking in his references to the queer things that happen on a Central American frontier. It was like the sensible talk of an intelligent traveler who has kept his eyes open and his notebook handy. The writer had not received a special training in the language of his own country nor in that of another; as a graduate from a technical college in Michigan he had acquired rather more of contempt than of love for the use of proper words in proper places, and yet, by dint of native intelligence and the desire to do his task well—the true professional spirit—he had succeeded in preparing an article that in its way was as good as that of the Oxford man. Both men were unaffected, both kept in mind the purpose of their writing, and both knew what they were talking about. The moral is that bad writing is due to insincerity, carelessness, or ignorance.

In the matter of the relative pronouns, as in that of preposition-verbs and hyphens—indeed, in almost everything concerning which I have endeavored to instruct you—you will find example—even authority—to the contrary. Writing is a flexible instrument of expression, and the same thing can be said in many ways. The great art is to write the thing in the way that makes it most easily understood by the reader—the particular reader or the class of readers for whom it is intended. In order to learn, we must, of course, look backward for precedents and for critical judgments, but we should also occasionally turn and look forward, and in that forward looking we should keep our eyes on the purpose of our work. Whether one great writer fail to distinguish between the relative pronouns or another use preposition-verbs like a German, does not matter greatly unless it hinder us in writing clearly on technical subjects. Amid the distortions of English and the uncertainties of rhetorical doctrine we shall not cry

despairingly "Whither are we drifting?" Rather let us ask hopefully "Whither shall we steer?" The answer is prompt: "Out of the fog, into the sunshine of clear plain English."

Technical writing rarely conforms to the higher requirements of literature, largely because it is difficult to persuade technicians to conform to the lower requirements of plain scientific statement. George M. Wood, the editor of the U. S. Geological Survey's publications, confesses that "the purist or stylist would not be satisfied with the work done. The split infinitive may remain, unless it is very awkwardly split; the doubtful singular or plural may go unchallenged—whether three feet of sandstone *are* seen or *is* seen makes no difference to the editor so long as the verb is everywhere seen in the same number in the same paper; the restrictive 'which' that might be 'that' may go to print unless it conveys or suggests a wrong idea; 'whose' may be used for either persons or things without editorial protest, if not with commendation. Whether something 'had better' or 'would better' be done; whether work was 'commenced' or 'begun'; whether the indicative should be used where a writer of the old school would prefer the subjunctive are questions that consume none of the time of the editors. Great latitude of expression and of style must be allowed, and the individuality of the author must be preserved—unless his individuality should consist principally in the repetition of faults of the kinds here described."

In the course of these lectures, I have quoted many examples of bad writing. You will have noticed that most of the faults criticised are due to carelessness rather than ignorance. Thoughtlessness is fatal in matters that demand thought. Slovenly writing is the result of slovenly thinking, for "slovenly habits of expression corrode the very substance of thought." * It behooves us to remember that language in relation to ideas is a solvent, the purity and clearness of which affect the matter in solution. Whewell, in the 'Philosophy of the Inductive Sciences', has expressed this view with noble eloquence.

* Allbutt.

“Language”, he said, “is often called an instrument of thought, but it is also the nutriment of thought; or rather it is the atmosphere in which thought lives; a medium essential to the activity of our speculative powers, although invisible and imperceptible in its operation, and an element modifying, by its qualities and changes, the growth and complexion of the faculties which it feeds.”

In considering this phase of the subject there comes to mind a suggestion that takes us far beyond the confines of the matter under discussion. Man's power of speech appears to divide him from all other living things; at the same time the imperfection of it weighs him down continually with the sense of an essential frailty. To be able to express oneself perfectly would be divine; to be unable to make oneself completely understood is human. In 'Man's Place in Nature' Huxley points out that the endowment of intelligible speech separates man from the brutes most nearly resembling him, the anthropoid apes, to whom he is otherwise akin in substance and in structure. This endowment of speech and the art of recording himself in writing enable man to transmit the experience that in other animals is lost with the individual life; they have enabled him to organize his knowledge and to hand it down to his descendants, first by word of mouth and then by written words. If the experience thus recorded were properly used, man's advancement in knowledge and in conduct would allow him to emphasize, much more than at present, his superiority over the dumb animals. Considered thus, language is a factor in the evolution of the race and an instrument that works for ethical progress—it is a gift to be cherished as the ladder by which man has climbed from his bestial origin and by which he may ascend to a loftier destiny, in which, ceasing to stammer in accents that are but the halting expression of swift thought, he shall unfold his mind in the fullness of speech, and, neither withholding what he wants to say nor saying what he wants to withhold, shall be linked to his fellows by a perfect communion of ideas.

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CIVIL ENGINEERING—Continued

5e Highways; Municipal Engineering; Sanitary Engineering; Water Supply. **Forestry. Horticulture, Botany and Landscape Gardening.**

6—Design. Decoration. Drawing: General; Descriptive Geometry; Kinematics; Mechanical.

ELECTRICAL ENGINEERING—PHYSICS

7—General and Unclassified; Batteries; Central Station Practice; Distribution and Transmission; Dynamo-Electro Machinery; Electro-Chemistry and Metallurgy; Measuring Instruments and Miscellaneous Apparatus.

8—Astronomy. Meteorology. Explosives. Marine and Naval Engineering. Military. Miscellaneous Books.

MATHEMATICS

9—General; Algebra; Analytic and Plane Geometry; Calculus; Trigonometry; Vector Analysis.

MECHANICAL ENGINEERING

10a General and Unclassified; Foundry Practice; Shop Practice.

10b Gas Power and Internal Combustion Engines; Heating and Ventilation; Refrigeration.

10c Machine Design and Mechanism; Power Transmission; Steam Power and Power Plants; Thermodynamics and Heat Power.

11—Mechanics.

12—Medicine. Pharmacy. Medical and Pharmaceutical Chemistry. Sanitary Science and Engineering. Bacteriology and Biology.

MINING ENGINEERING

13—General; Assaying; Excavation, Earthwork, Tunneling, Etc.; Explosives; Geology; Metallurgy; Mineralogy; Prospecting; Ventilation.

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